Caption

☐ = Figure number of the diagram.

* = See note indicated by the letter.

-BER = SOR Test Unit device for monitoring the continuity of the shunt opening and closing release winding (see note D)

-BGB1, 2, 3, 8 = Auxiliary contacts of circuit-breaker.

-BGB4 = Auxiliary let-through contact of circuit-breaker with momentary closing during circuit-breaker opening.

-BGB6 = Contact for electrical signalling of undervoltage release de-energized.

-BGB11 = Contact for cutting off electrical signal -BGB4 if opening operation is performed in the manual mode.

-BGS1 = Limit contact of spring loading motor.

-BGS2 = Contact for signalling closing springs loaded-discharged.

-MAS = Motor for loading closing springs (see note C).

-MBC = Shunt closing release (see note D).

-MBO1 = First shunt opening release (see note D).

-MBO2 = Second shunt opening release (see note D).

-MBO3 = Opening solenoid for release outside circuit-breaker.

-MBO4 = Third shunt opening release (see note D).

-MBU = Undervoltage release (see note B).

-QAB = Circuit-breaker applications.

-RLE1 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (Consumption can be limited by connecting a delayed operation enabling pushbutton in series).

-SFC = Pushbutton or contact for closing circuit-breaker.

-SFO = Pushbutton or contact for opening circuit-breaker.

-TB7 = Rectifier for release -MBO3.

-XDB = Terminal box of circuit-breaker circuits.

-XDB10, ... ,17 = Connectors of applications

Description of the figures

Fig. 1 = Circuit of motor for loading closing springs (see note C).

Fig. 2 = Shunt closing release (anti-pumping is achieved mechanically), (see note D).

Fig. 3 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation.

Fig. 5 = Instantaneous undervoltage release (see note B).

Fig. 6 = Circuit of third opening release with continuous control of winding (see note D).

Fig. 7 = Circuit of first opening release with continuous control of winding (see note D).

Fig. 9 = Circuit of second opening release with continuous control of winding (see note D).

Fig. 10 = Opening solenoid for release outside circuit-breaker.

Fig. 11 = Opening solenoid for release outside circuit-breaker with AC supply.

Fig. 26 = Electrical signalling of closing springs loaded and discharged.

Fig. 30 = Auxiliary let-through contact of circuit-breaker with momentary closing during circuit-breaker opening.

Fig. 31 = Available auxiliary contacts of circuit-breaker.

Fig. 32, ..., 35 = Available auxiliary contacts of circuit-breaker.

Fig. 60 = Contact for electrical signalling of undervoltage release de-energized.

Fig. 70, ..., 73 = Available auxiliary contacts of circuit-breaker.

5. Electric circuit diagram

Incompatibility

The circuits indicated in the following figures cannot be supplied at the same time in the same circuit-breaker:

5-6 10-11 32-33-34-35 70-71 -72-73

Notes

A) Circuit-breaker is equipped solely with the applications specified in the order confirmation. Consult this catalogue for information about how to make out an order.

B) The undervoltage release can be supplied for energizing with voltage derived from the supply side of the circuit-breaker or from an independent source.
Circuit-breaker closing is only allowed when the release is energized (closing lock is obtained mechanically). If there is the same power supply for the shunt closing and under-voltage releases and the circuit-breaker must close automatically when auxiliary voltage returns, there must be a 50 ms delay between the under-voltage release's enabling instant and energizing of the shunt closing release.
Incompatible with -MBO4.

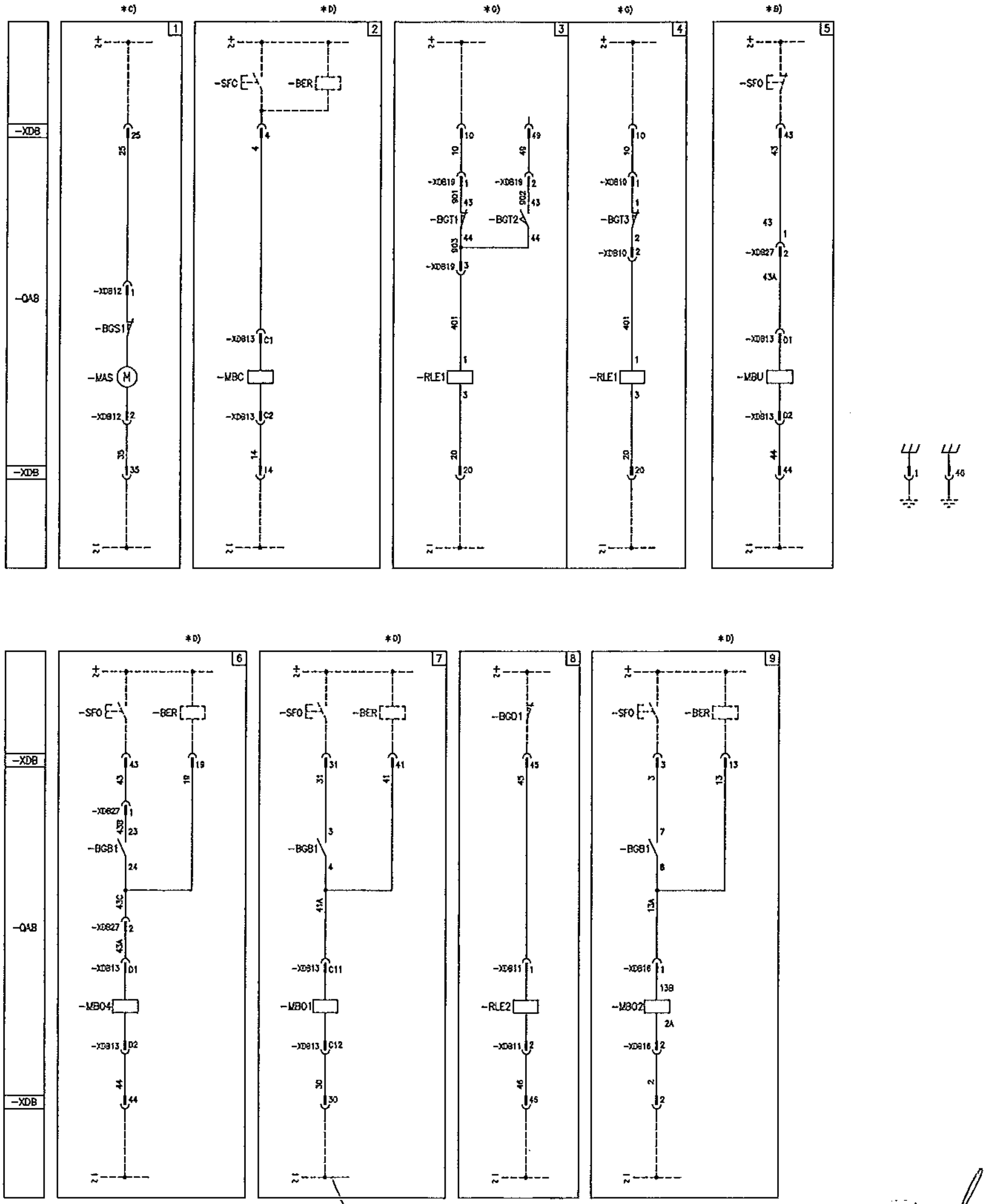
C) Check power of auxiliary circuit to find out whether several motors for loading the closing springs can be operated at the same time. To prevent excessive power draw, springs must be loaded by hand before auxiliary circuit is powered.

D) The circuit for monitoring the continuity of the release windings must only be used for that purpose. The SOR Test Unit can be used for checking the continuity of the various different releases.

E) When fig. 6 is required, contact -BGB3 (41-42) of fig. 32-33 is not available and fig. 34-35 cannot be supplied.
When fig. 9 is required, contact -BGB1 (43-44) of fig. 31 is not available.

F) Only available for 31.5 kA.

Electric circuit diagram of withdrawable circuit-breakers for UniGear switchgear and PowerCube enclosure 12 .. 24 kV 1VCD 400155

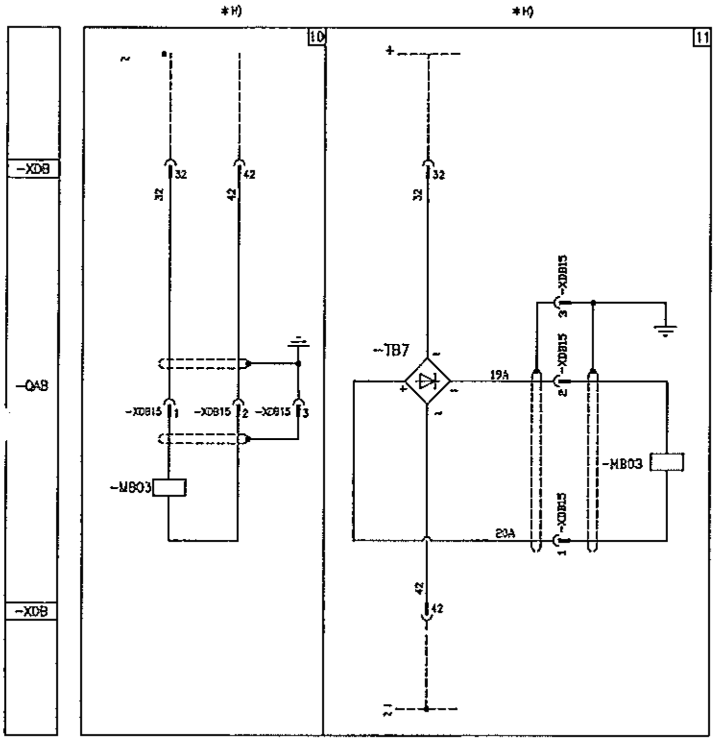


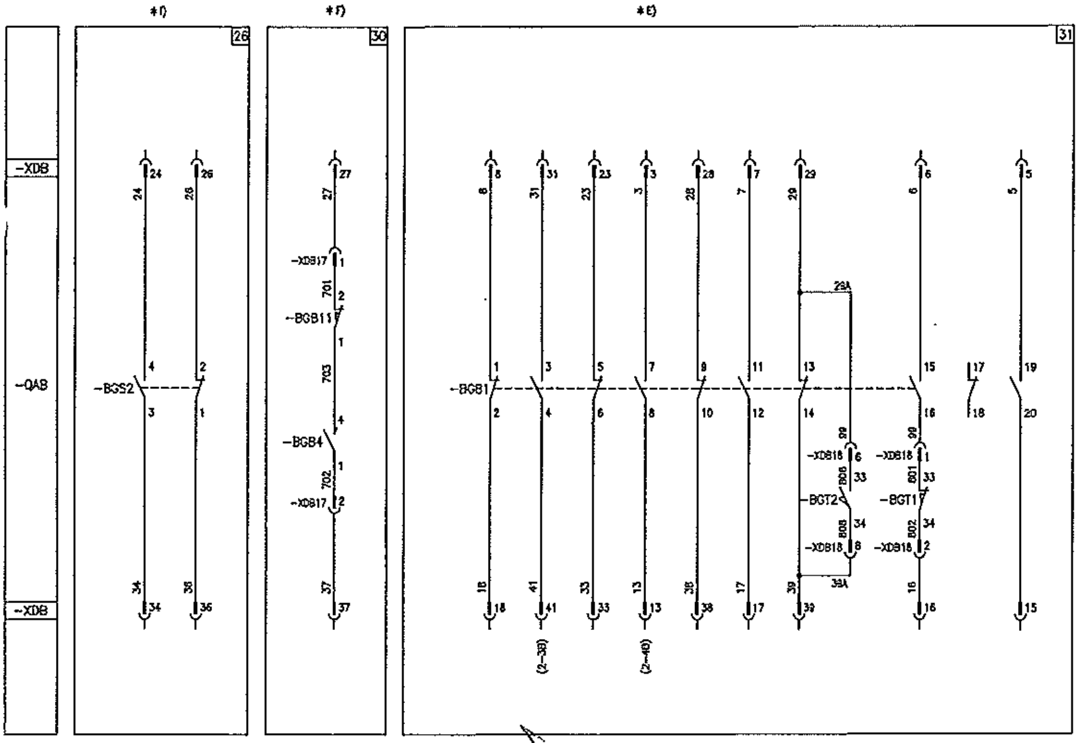
5. Electric circuit diagram

The electric circuit diagram given in this section regards the withdrawable circuit-breakers for UniGear switchgear and PowerCube 12 .. 24 kV enclosures; for withdrawable circuit-breakers with motorized truck, see diagram 1VCD400156.

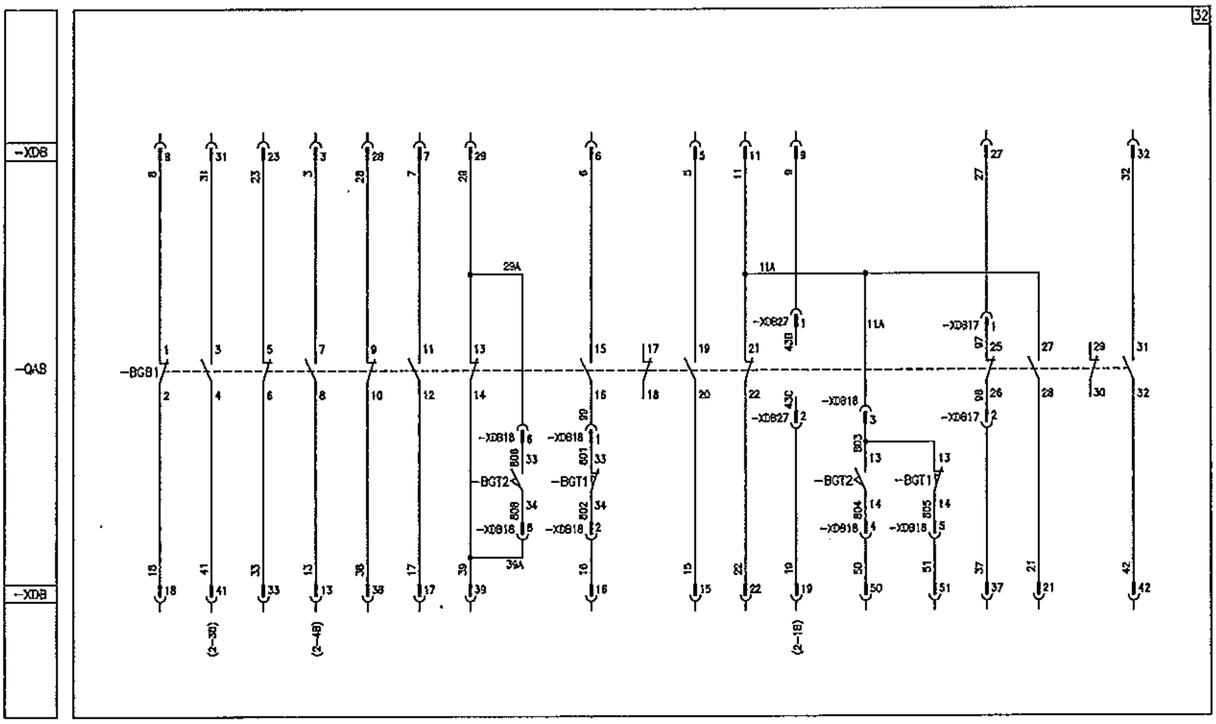
For circuit-breaker of ZS8.4 switchgears the following diagrams are available:

1VCD400158 Standard version
1VCD400159 Version with motorized truck.

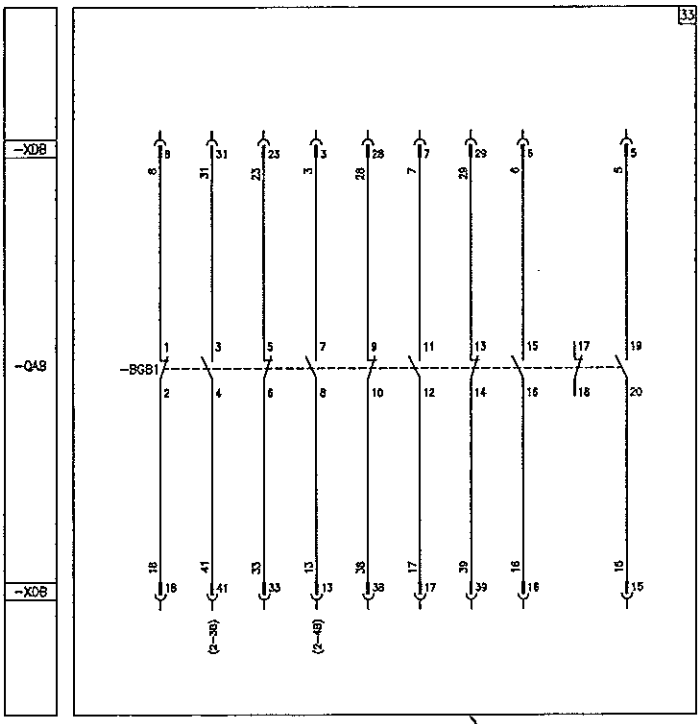




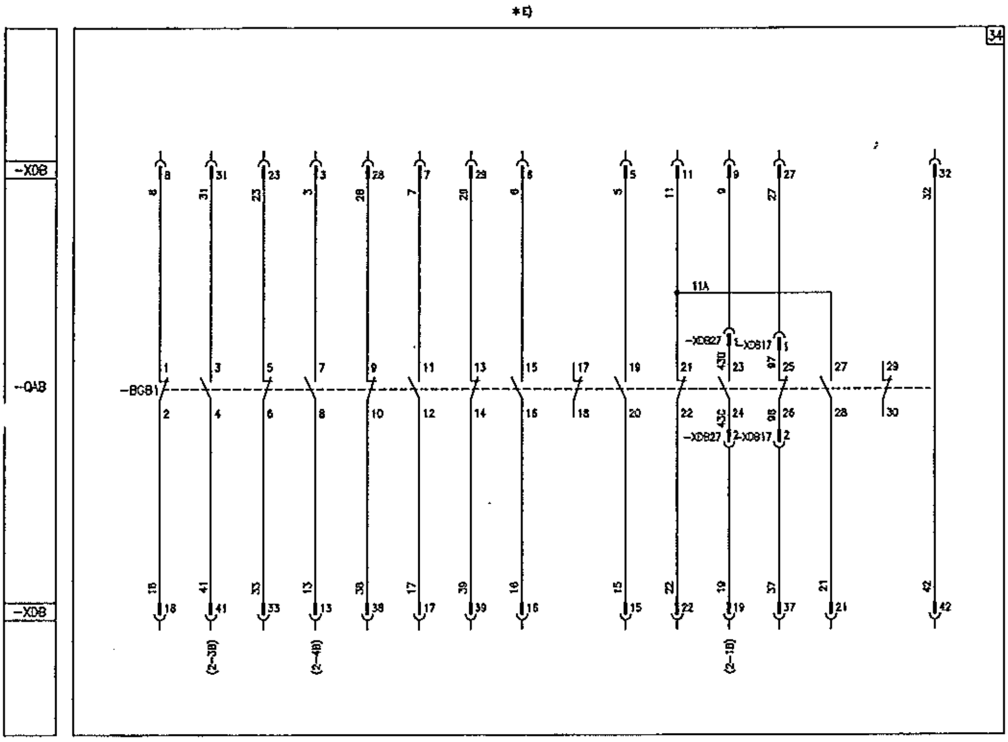
*E)

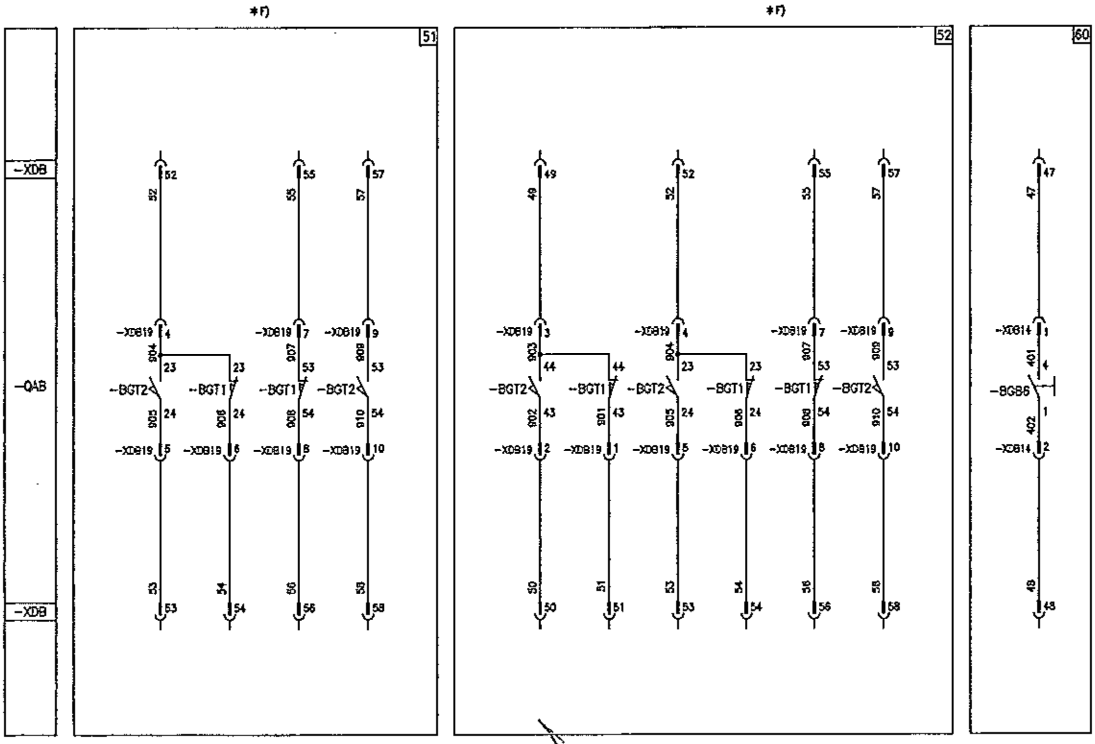

32
-XDB
-QAB
-XDB
-BGB1
29A
39A
11A
-XDB18
-BGT2
-BGT1
-XDB27
-XDB17
430
43C
803
804
805
806
808
801
802
(2-3B)
(2-4B)
(2-1B)

*E)


33
-XDB
-QAB
-XDB
-BGB1
(2-3B)
(2-4B)

5. Electric circuit diagram





Caption

☐ = Figure number of the diagram.

* = See note indicated by the letter.

-BER = SOR Test Unit device for monitoring continuity of shunt opening and closing release winding (see note D)

-BGB1 = Auxiliary contacts of circuit-breaker.

-BGB4 = Auxiliary let-through contact of circuit-breaker with momentary closing during circuit-breaker opening.

-BGB6 = Contact for electrical signalling of undervoltage release de-energized.

-BGB11 = Contact for cutting off electrical signal -BGB4 if opening operation is performed in the manual mode.

-BGD1 = Enclosure door position contact.

-BGS1 = Limit contact of spring loading motor.

-BGS2 = Contact for signalling closing springs loaded-discharged.

-BGT1 = Electrical signalling contacts for circuit-breaker in racked-in position (see note F)

-BGT2 = Electrical signalling contacts for circuit-breaker in isolated position (see note F).

-BGT3 = Circuit-breaker position contact, open during isolating travel.

-MAS = Motor for loading closing springs (see note C).

-MBC = Shunt closing release (see note D).

-MBO1 = First shunt opening release (see note D).

-MBO2 = Second shunt opening release (see note D).

-MBO3 = Opening solenoid for release outside circuit-breaker.

-MBO4 = Third shunt opening release (see note D).

-MBU = Under-voltage release (see note B).

-QAB = Circuit-breaker applications.

-RLE1 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation).

-RLE2 = Locking magnet (on truck). Mechanically inhibits circuit-breaker racking-in and isolating if de-energized. (Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation).

-SFC = Pushbutton or contact for closing circuit-breaker.

-SFO = Pushbutton or contact for opening circuit-breaker.

-TB7 = Rectifier for release -MBO3.

-XDB = Terminal box of circuit-breaker circuits.

-XDB10, ... , 27 = Connectors of applications

-XDB28 = Connector of applications.

Description of the figures

Fig. 1 = Circuit of motor for loading closing springs (see note C).

Fig. 2 = Shunt closing release (anti-pumping is achieved mechanically). (see note D).

Fig. 3 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (If -RL1 is required, provide this figure when fig.31 or 32 are selected). Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation.

Fig. 4 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (If -RL1 is required, provide this figure when fig.33 or 34 are selected). Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation.

Fig. 5 = Instantaneous undervoltage release (see note B).

Fig. 6 = Circuit of third opening release with continuous control of winding (see note D).

Fig. 7 = Circuit of first opening release with continuous control of winding (see note D).

Fig. 8 = Locking magnet (on truck). Mechanically inhibits circuit-breaker racking-in and isolating if de-energized. (Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation).

Fig. 9 = Circuit of second opening release with continuous control of winding (see note D).

Fig. 10 = Opening solenoid for release outside circuit-breaker.

Fig. 11 = Opening solenoid for release outside circuit-breaker with AC supply.

5. Electric circuit diagram

Fig. 26 = Electrical signalling of closing springs loaded and discharged.

Fig. 30 = Auxiliary let-through contact of circuit-breaker with momentary closing during circuit-breaker opening.

Fig. 31, ... , 34 = Available auxiliary contacts of circuit-breaker (see note E).

Fig. 51 = Contacts for electrical signalling of circuit-breaker in racked-in and isolated positions located on circuit-breaker truck (obligatory when fig. 31 or 32 are required).

Fig. 52 = Contacts for electrical signalling of circuit-breaker in racked-in and isolated positions located on circuit-breaker truck (supplied on request when fig. 33 to 34 are required).

Fig. 60 = Contact for electrical signalling of undervoltage release de-energized.

Incompatibility

The circuits indicated in the following figures cannot be supplied at the same time in the same circuit-breaker:

3-4	3-33-34	4-31-32	5-6	10-11
31-32-33-34	31-32-52	33-34-51	51-52	

Notes

A) Circuit-breaker is equipped solely with the applications specified in the order confirmation. Consult this catalogue for information about how to make out an order.

B) The undervoltage release can be supplied for energizing with voltage derived from the supply side of the circuit-breaker or from an independent source.
Circuit-breaker closing is only allowed when the release is energized (closing lock is obtained mechanically). If there is the same power supply for the shunt closing and under-voltage releases and the circuit-breaker must close automatically when auxiliary voltage returns, there must be a 50 ms delay between the under-voltage release's enabling instant and energizing of the shunt closing release.
Incompatible with -MBO4.

C) Check power of auxiliary circuit to find out whether several motors for loading the closing springs can be operated at the same time. To prevent excessive power draw, the springs must be loaded by hand before auxiliary circuit is powered.

D) The circuit for monitoring the continuity of the release windings must only be used for that purpose. The SOR Test Unit can be used for checking the continuity of the various different releases:
-MBO4 incompatible with -MBU.
-MBO4 not available on Vmax and VD4 50kA.

E) When fig. 6 is required, contact -BGB1 (23-24) of fig. 32-34 is not available.
When fig. 7 is required, contact -BGB1 (3-4) of fig. 31-32-33-34 is not available.
When fig. 9 is required, contact -BGB1 (7-8) of fig. 31-32-33-34 is not available.
When fig. 10 or 11 are required, contact -BGB1 (31-32) of fig. 32 and 34 is not available.
When fig. 30 is required, contact -BGB1 (25-26) of fig. 32 and 34 is not available.

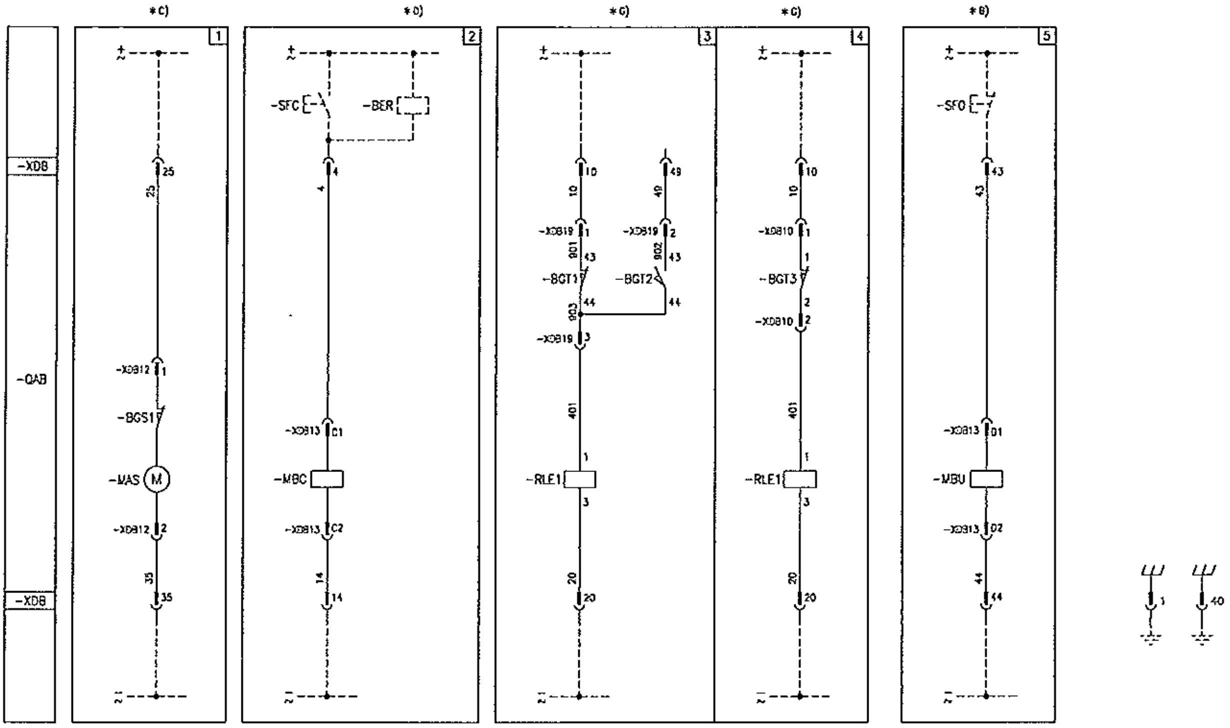
F) The contacts for electrical signalling of circuit-breaker in isolated and racked-in position (-BGT1 and BGT2) shown in fig. 51-52 are installed on circuit-breaker truck (movable part).

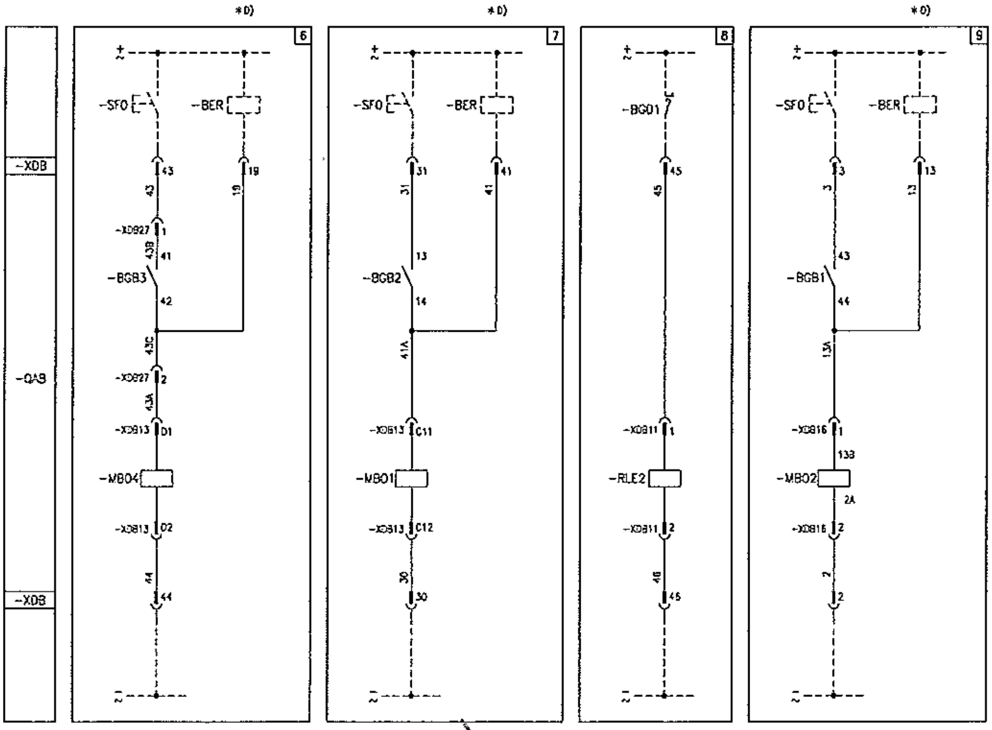
G) Fig. 3 is supplied when fig. 31 or 32 are required.
Fig. 4 is supplied when fig. 33 or 34 are required (in this case, it is obligatory to supply –BGT3).

H) Fig. 10 is only available for VD4 up to 31.5 kA and Vmax.
Fig. 11 is only available for VD4 up to 31.5 kA.

I) The energizing voltage must be the same for both signals.

Electric circuit diagram of withdrawable circuit-breakers 36 kV 1VCD 400237

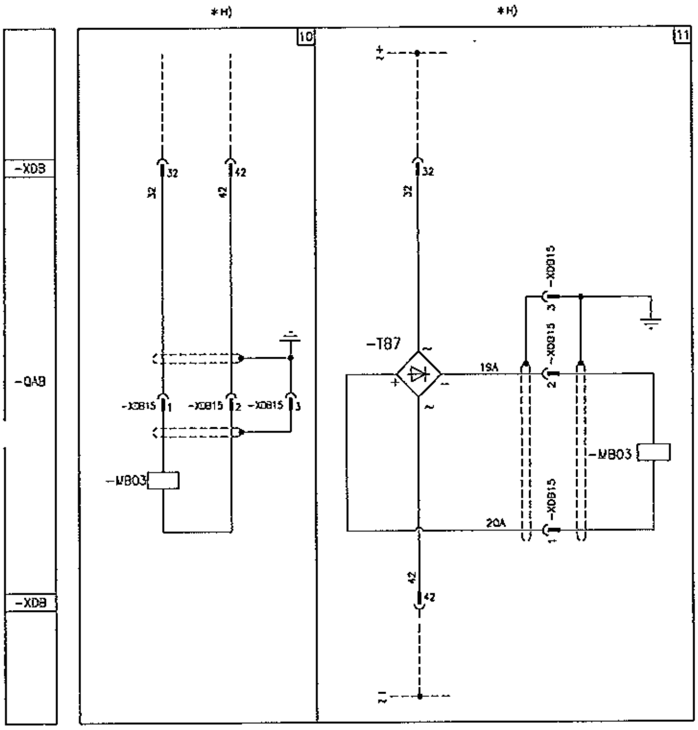


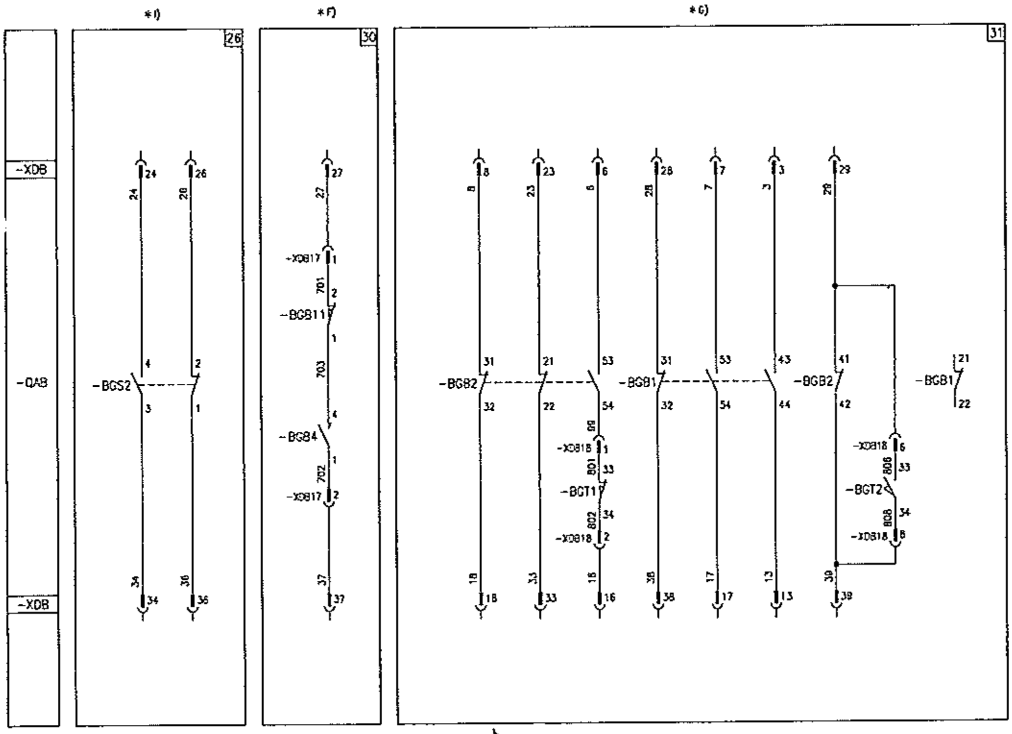


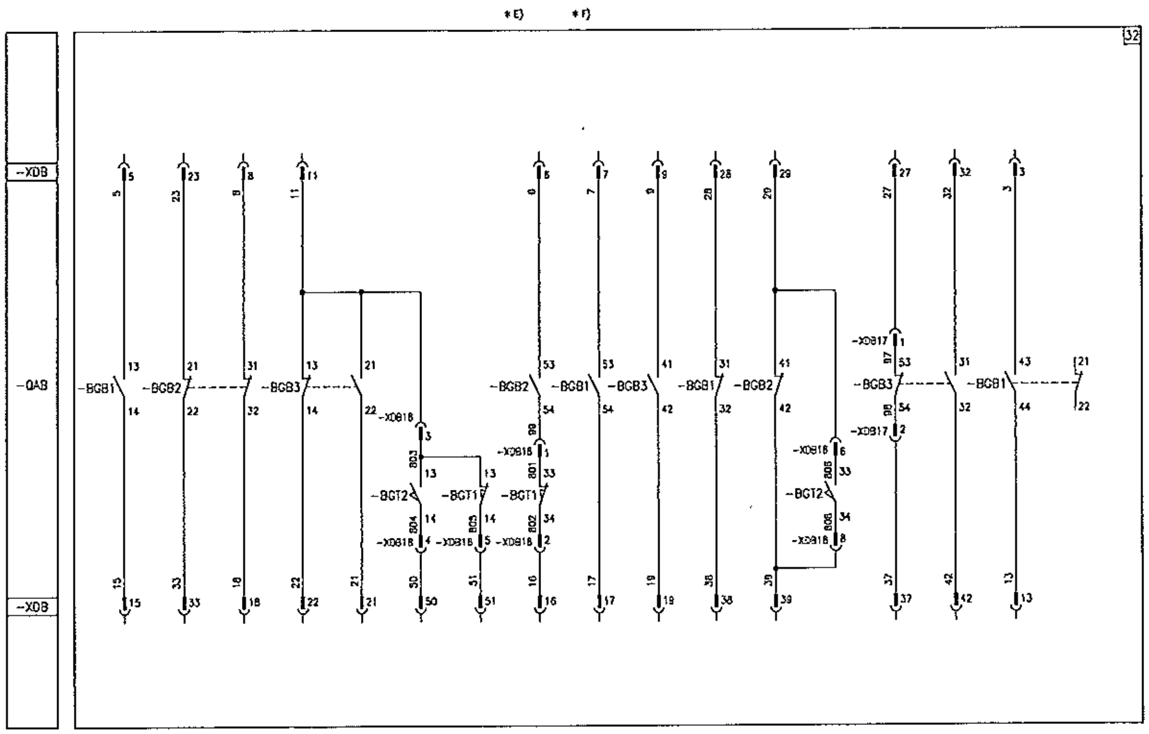
5. Electric circuit diagram

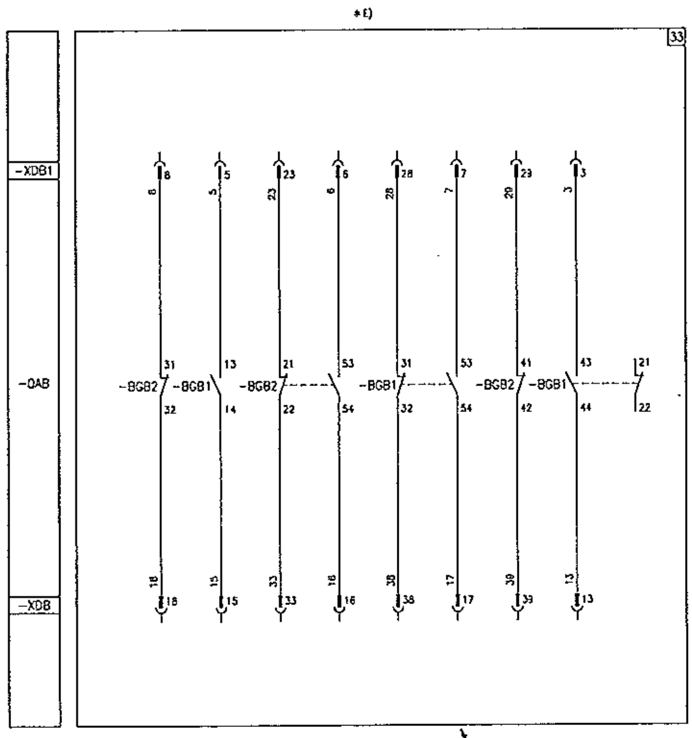
The electric circuit diagram given in this section regards the withdrawable circuit-breakers with **breaking capacity up to** 36 kV.

Note: the withdrawable version with motor-operated truck is not available for 36 kV.

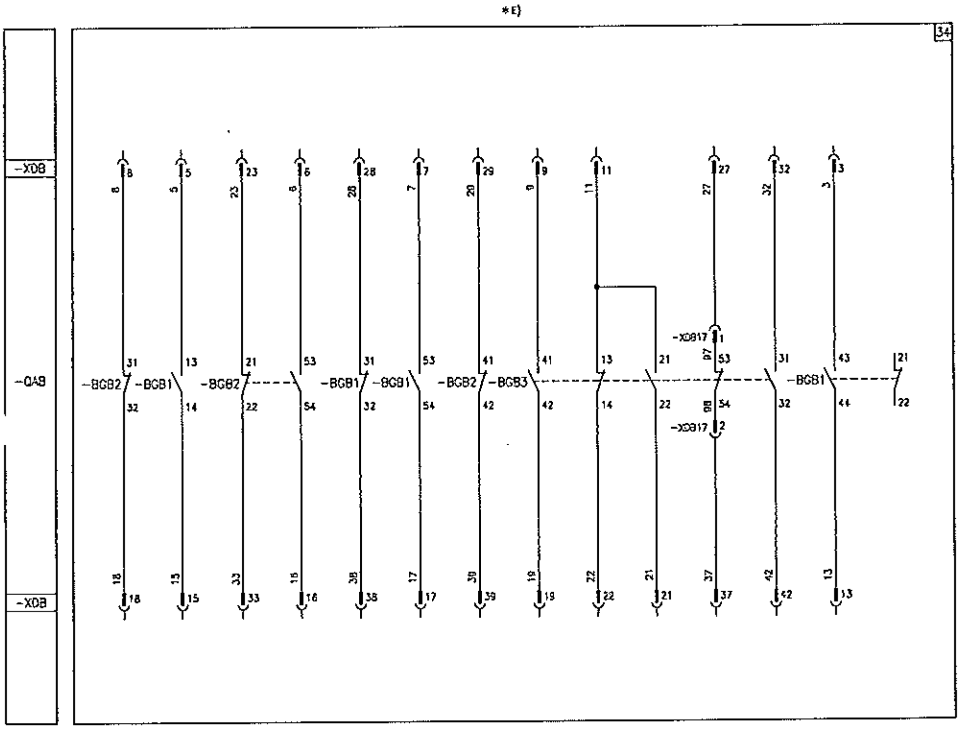


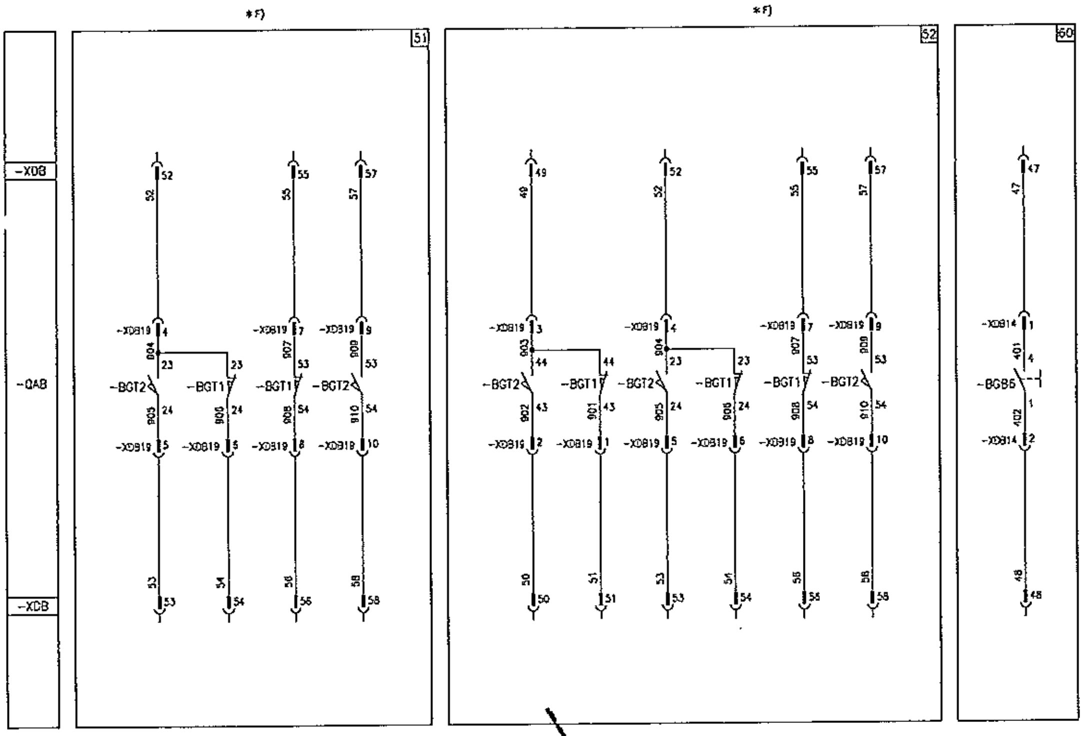



* E)
* F)
32
-XDB
-QAB
-XDB
-BGB1
-BGB2
-BGB3
-BGB1
-BGB2
-BGB3
-BGB1
-BGB2
-BGB3
-BGB1
-XDB18
-BGT2
-BGT1
-BGT1
-BGT2
-XDB17
5
23
8
11
6
7
9
28
29
27
32
3
15
33
18
22
21
50
51
16
17
19
38
39
37
42
13


* E)
33
-XDB1
-QAB
-XDB
-BGB2
-BGB1
-BGB2
-BGB1
-BGB2
-BGB1
8
5
23
6
28
7
29
3
18
15
33
16
38
17
39
13

5. Electric circuit diagram





Caption

☐ = Figure number of the diagram.

* = See note indicated by the letter.

-BER = SOR Test Unit device for monitoring continuity of shunt opening and closing release winding (see note D)

-BGB1, ... ,3 = Auxiliary contacts of circuit-breaker.

-BGB4 = Auxiliary let-through contact of circuit-breaker with momentary closing during circuit-breaker opening.

-BGB6 = Contact for electrical signalling of undervoltage release de-energized.

-BGB11 = Contact for cutting off electrical signal -BGB4 if opening operation is performed in the manual mode.

-BGD1 = Enclosure door position contact.

-BGS1 = Limit contact of spring loading motor.

-BGS2 = Contact for signalling closing springs loaded-discharged.

-BGT1 = Electrical signalling contacts for circuit-breaker in racked-in position (see note F).

-BGT2 = Contacts for electrical signalling of circuit-breaker in isolated position (see note F).

-BGT3 = Circuit-breaker position contact, open during isolating travel.

-MAS = Motor for loading closing springs (see note C).

-MBC = Shunt closing release (see note D).

-MBO1 = First shunt opening release (see note D).

-MBO2 = Second shunt opening release (see note D).

-MBO3 = Opening solenoid for release outside circuit-breaker.

-MBO4 = Third shunt opening release (see note D).

-MBU = Under-voltage release (see note B).

-QAB = Circuit-breaker applications.

-RLE1 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (Consumption can be limited by connecting a delayed operation enabling pushbutton in series).

-RLE2 = Locking magnet (on truck). Mechanically inhibits circuit-breaker racking-in and isolating if de-energized. (Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation).

-SFC = Pushbutton or contact for closing circuit-breaker.

-SFO = Pushbutton or contact for opening circuit-breaker.

-TB7 = Rectifier for release -MBO3.

-XDB = Terminal box of circuit-breaker circuits.

-XDB10, ... , 27 = Connectors of applications.

-XDB28 = Connector of applications.

Description of the figures

Fig. 1 = Circuit of motor for loading closing springs (see note C).

Fig. 2 = Shunt closing release (anti-pumping is achieved mechanically), (see note D).

Fig. 3 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (If -RL1 is required, provide this figure when fig. 31 or 32 are selected). Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation.

Fig. 4 = Locking magnet. Mechanically inhibits circuit-breaker closing if de-energized. (If -RL1 is required, provide this figure when fig.33 or 34 are selected). Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation.

Fig. 5 = Instantaneous undervoltage release (see note B).

Fig. 6 = Circuit of third opening release with continuous control of winding (see note D).

Fig. 7 = Circuit of first opening release with continuous control of winding (see note D).

5. Electric circuit diagram

Fig. 8 = Locking magnet (on truck). Mechanically inhibits circuit-breaker racking-in and isolating if de-energized. (Consumption can be limited by connecting a delayed pushbutton in series so as to enable the operation).

Fig. 9 = Circuit of second opening release with continuous control of winding (see note D).

Fig. 10 = Opening solenoid for release outside circuit-breaker.

Fig. 11 = Opening solenoid for release outside circuit-breaker with AC supply.

Fig. 26 = Electrical signalling of closing springs loaded and discharged.

Fig. 30 = Auxiliary let-through contact of circuit-breaker with momentary closing during circuit-breaker opening.

Fig. 31, ... , 34 = Available auxiliary contacts of circuit-breaker (see note E).

Fig. 51 = Contacts for electrical signalling of circuit-breaker in racked-in and isolated positions located on circuit-breaker truck (obligatory when fig.31 or 32 are required).

Fig. 52 = Contacts for electrical signalling of circuit-breaker in racked-in and isolated positions located on circuit-breaker truck (supplied on request when fig.33 to 34 are required).

Fig. 60 = Contact for electrical signalling of undervoltage release de-energized.

Incompatibility

The circuits indicated in the following figures cannot be supplied at the same time in the same circuit-breaker:

3-4
31-32-33-34
3-33-34
31-32-52
4-31-32
33-34-51
5-6
51-52
10-11

Notes

A) The circuit-breaker is equipped solely with the applications specified in the order confirmation. Consult this catalogue for information about how to make out an order.

B) The undervoltage release can be supplied for energizing with voltage derived from the supply side of the circuit-breaker or from an independent source.
Circuit-breaker closing is only allowed when the release is energized (closing lock is obtained mechanically). If there is the same power supply for the shunt closing and under-voltage releases and the circuit-breaker must close automatically when auxiliary voltage returns, there must be a 50 ms delay between the under-voltage release's enabling instant and energizing of the shunt closing release.
Incompatible with -MBO4.

C) Check power of auxiliary circuit to find out whether several motors for loading the closing springs can be operated at the same time. To prevent excessive power draw, springs must be loaded by hand before auxiliary circuit is powered.

D) The circuit for monitoring the continuity of the release windings must only be used for that purpose. The SOR Test Unit can be used for checking the continuity of the various different releases.
-MBO4 incompatible with -MBU.

E) When fig. 6 is required, contact -BGB3 (41-42) of fig. 32-34 is not available.
When fig. 9 is required, contact -BGB1 (43-44) of fig. 31-32-33-34 is not available.
When fig. 10 or 11 are required, contact -BGB3 (31-32) of fig. 32 and 34 is not available.
When fig. 30 is required, contact -BGB3 (53-54) of fig. 32 and 34 is not available.

F) The contacts for electrical signalling of circuit-breaker in racked-in and isolated positions (-BGT1 and -BGT2) shown in fig. 51-52 are located on circuit-breaker truck (moving part).

G) Fig. 3 is supplied when fig. 31 or 32 are required. Fig. 4 is supplied when fig. 33 or 34 are required (in this case, it is obligatory for -BGT3 to be supplied).

H) Fig. 10 is only available for VD4 up to 31.5 kA. Fig. 11 is only available for VD4 up to 31.5 kA.

I) The energizing voltage must be the same for both signals.

Contact us

ABB S.p.A.
Electrification Products Division
Medium Voltage Products
Via Friuli, 4
I-24044 Dalmine
Tel.: +39 035 6952 111
Fax: +39 035 6952 874
E-mail: info.mv@it.abb.com

ABB AG (1)
Calor Emag Medium Voltage Products
Oberhausener Strasse 33 Petzower Strasse 8
D-40472 Ratingen D-14542 Glindow
Phone: +49(0)2102/12-1230
Fax: +49(0)2102/12-1916
E-mail: powertech@de.abb.com

www.abb.com

1VCP000001 - Rev. V, en - Technical catalogue - 2016.04 (VD4-50 kA) (gs)

Power and productivity
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Приложение 1.2 - Типови_изпитания

PEHLA
GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0045 Ra **Copy No.:** 0 **Contents:** 19 Sheets

Equipment under test:	Metal-clad air-insulated switchgear panel type ZS1.2, rated voltage 24 kV, drawing-no. GCE 8010459 R0104, with vacuum circuit-breaker type VD4P 2420-25.
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Client:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Testing station:	PEHLA - Testing Station Ratingen
Date of test:	28th November 2000
Applied test specifications:	IEC 60298: 1990-12, clauses 6.1.1, 6.1.3 - 6.1.7, IEC 60694: 1996-05, clauses 6.2.1, 6.2.3 - 6.2.6.
Tests performed:	Dielectric type test. Standard lightning impulse withstand voltage test at 125 kV and power-frequency withstand voltage test at 50 kV to earth, between phases and across open switching device.
Test results:	The ZS1.2-type panel passed the dielectric type test successfully. The respective requirements are met.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 07th December 2000

The test results relate only to the items tested.

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Deutscher Akkreditierungs Rat
DAR
DAT-P-032/93

Accreditation

The PEHLA-Testing Station Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN 45001 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN 45001 PEHLA states the following:

- The accreditation of the PEHLA-Testing Station or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Station this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N; S, SF) and STLNA (USA). In the framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STLGuides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office:
PEHLA-Geschäftsstelle
Hallenweg 40
D-68219 Mannheim

Testing Station:
PEHLA-Testing Station Ratingen
Oberhausener Str. 33
D-40472 Ratingen

Manufacturer:
ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
D-40472 Ratingen

Client:
ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
D-40472 Ratingen

Table of Contents

List of Test Participants

Representatives of the Test Committee:

Mr. A. Meier	PEHLA- Testing Station Ratingen
Mr. W. Stolz	PEHLA- Testing Station Mannheim

Test Engineer:

Mr. U. Lisseck	PEHLA- Testing Station Ratingen

Other Particiipants: -

Technical Data of Test Object

Switchgear

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 07550027/2017/00 **Year of manufacture:** 2000
Drawing No.: GCE8010459 R0104 index 00

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current of busbar	2500	A
Rated normal current of tee-off	2500	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Insulating medium	air	
Rated operating pressure (abs./20 °C)	-	kPa
Minimum operating pressure (abs./20 °C)	-	kPa
Permissible values for internal arc faults:		
Peak current	63	kA
Short-time current	25	kA
Duration of short-circuit	1	s
Max. ambient air temperature	40	°C

The above switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

-- busbar 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated, with bushing plate (left and right).
-- busbar tee-off conductor 2 x 100 mm x 10 mm / R 5 mm, Cu, insulated.
-- tulip insulator with contact pin Ø = 79 mm.
-- current transformer type TPU 65.11, manufacturer: ABB,
serial-no. L1: 058 246; L2: 058 247; L3: 058 248.
-- earthing switch type EK6 2406-275, serial-no. 06/050/00.
-- cable conductor 2 x 100 mm x 10 mm / R 5 mm, Cu, bare.

Date of receipt of test object: 27th November 2000

Technical Data of Test Object

Switching Device - Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4P 2420-25
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7008269/4002/00 **Year of manufacture:** 2000
Drawing No.: GCE 7000162 R1104 index 00 (circuit-breaker)
Vacuum interrupter: Type VG4S, L1: No. 00G4S01196, L2: No. 00G4S01192, L3: No. 00G4S01194
Drawing No.: GCE 7005535 R0102 index 02 (interrupter)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	2000	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	25	kA
D.C. component	30	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage:		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	Vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Max. ambient air temperature	40	°C
Further specifications:	-	

Essential characteristics: -

Date of receipt of test object: 27th November 2000

List of Drawings

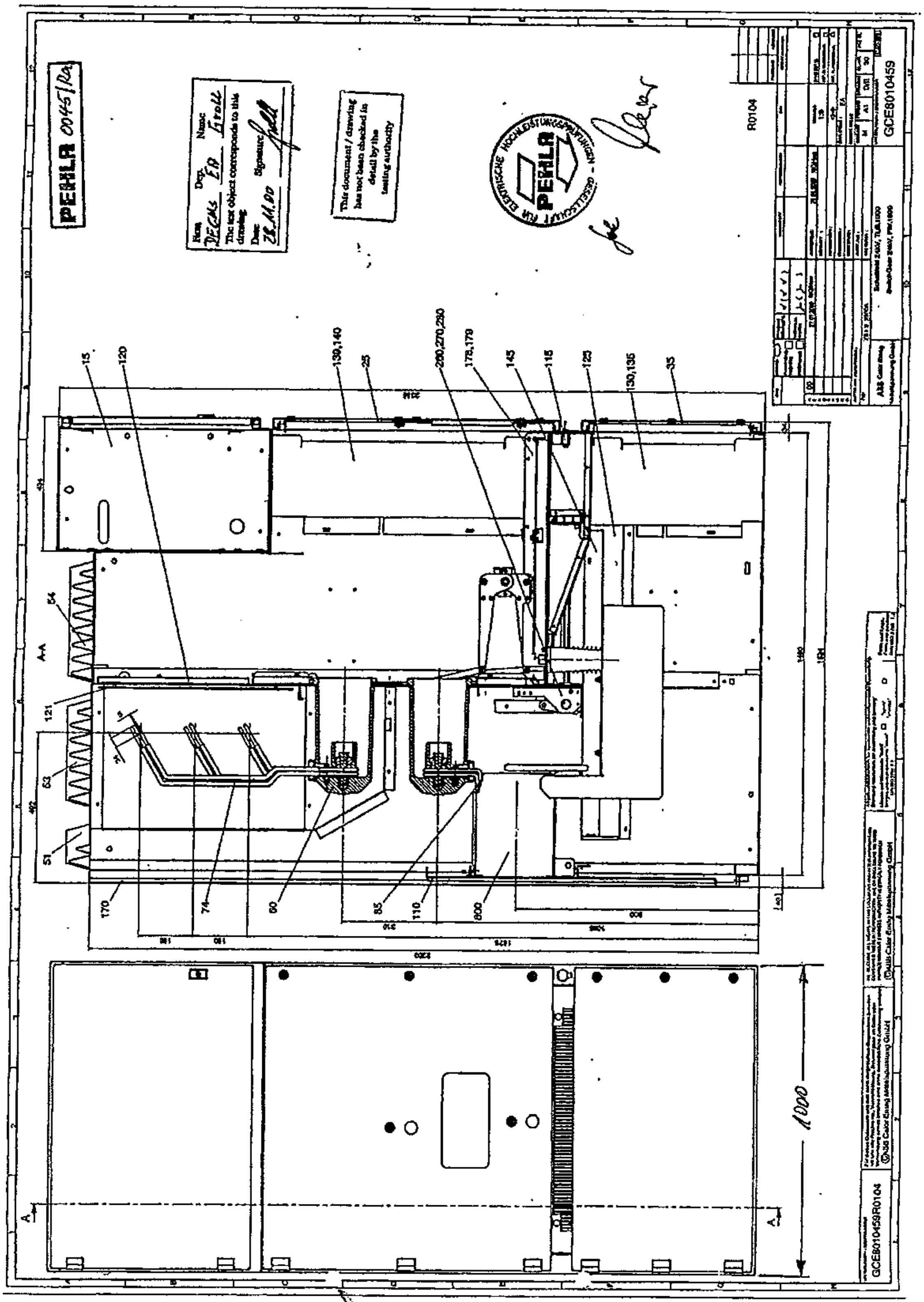
The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represented the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

☒ with the test documents at the test laboratory.

☐ at the client.

A copy of the following drawings is part of this Test Report.

Drawing-No.	Index	Title	Additional remarks
GCE 8010459 R0104	00	SwitchGear 24kV; PW.1000	-
GCE 8012050 R0101	01	Cable connecting bar system 2500A	-
GCE 7000162 R1104	00	Einschub für ZS1.2 24kV VD4P 2420..25	-



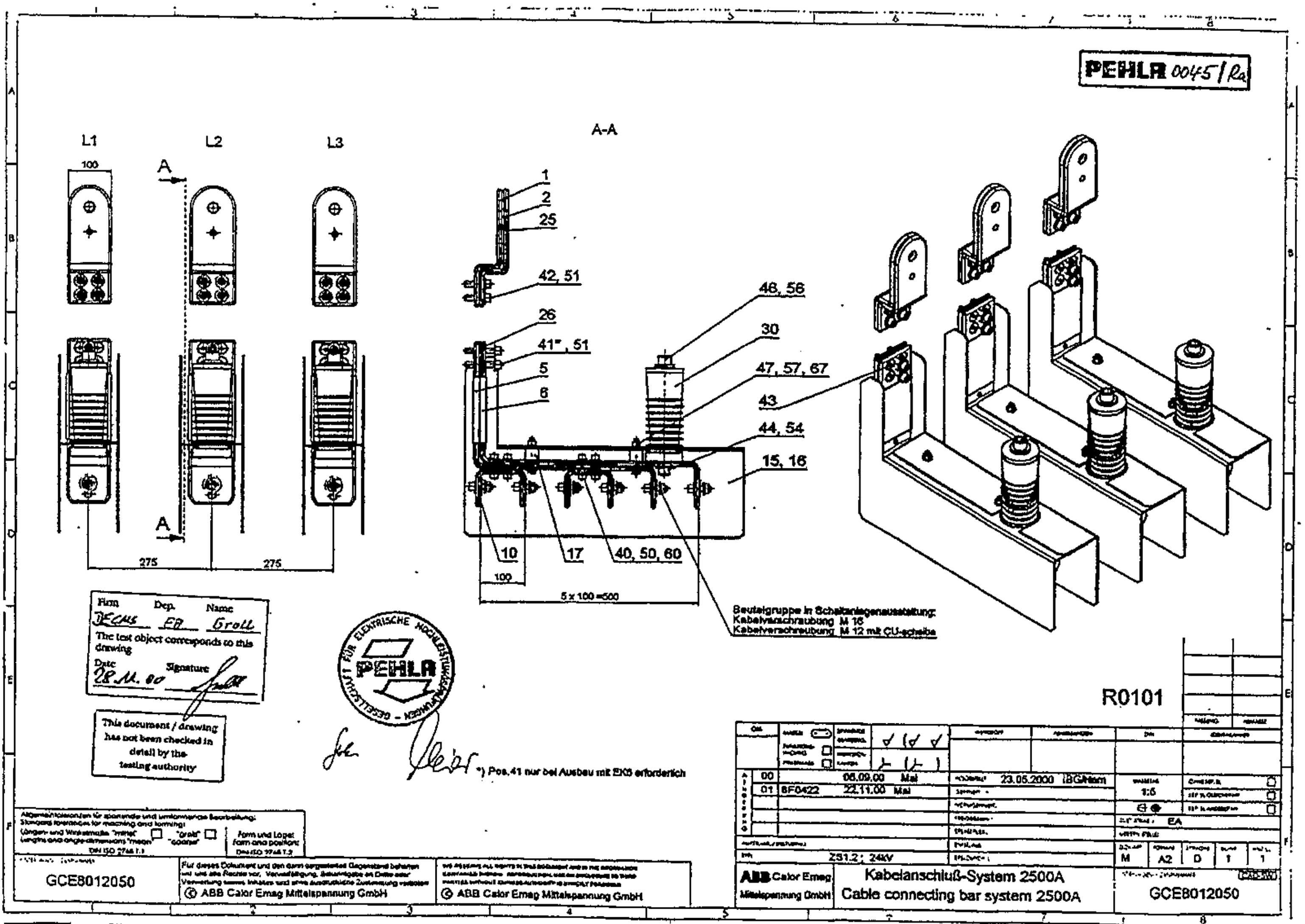
PEHLA 0045/Ra

Firm DECMS Dep. EA Name Eroll
The test object corresponds to this drawing
Date 28.11.00 Signature

This document / drawing has not been checked in detail by the testing authority

PEHLA

PEHLA 0045/Ra



Beutelgruppe in Schaltanlagenausstattung:
Kabelverschraubung M 16
Kabelverschraubung M 12 mit CU-scheibe

*) Pos.41 nur bei Ausbau mit EK5 erforderlich

R0101

Firm: JECMS Dep.: EB Name: Groll
The test object corresponds to this drawing
Date: 28.11.00 Signature

This document / drawing has not been checked in detail by the testing authority

PEHLA

Allgemeintoleranzen für spanende und umformende Bearbeitung:
Standard tolerances for machining and forming:
Längen- und Winkelmaße "mittel" ☐ "grob" ☐
Lengths and angle-dimensions "mean" "coarse"
DIN ISO 2768 T.1
Form und Lage: form and position: DIN ISO 2768 T.2

GCE8012050

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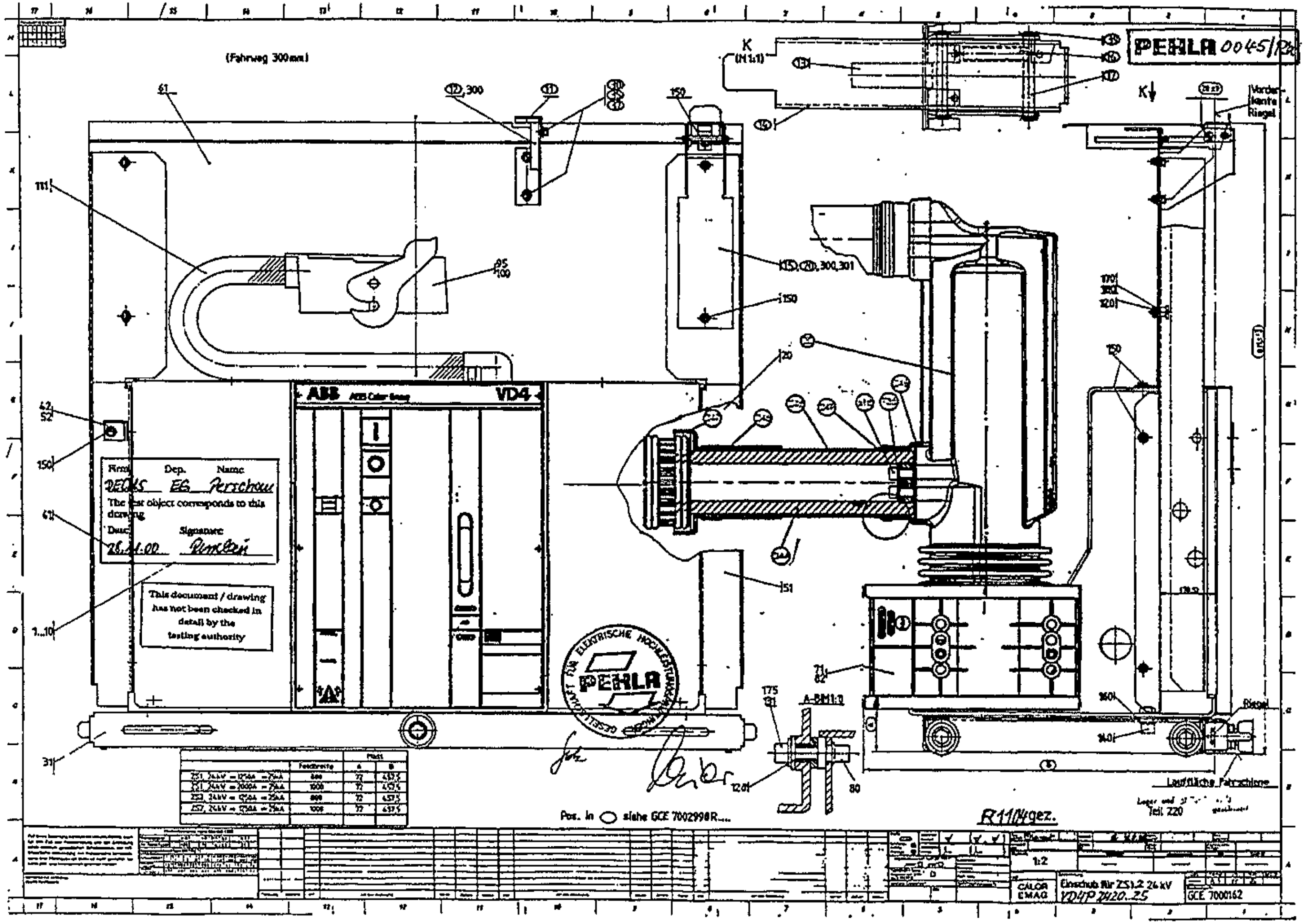
00		06.09.00	Mai
01	8F0422	22.11.00	Mai

23.05.2000 (BG/Nam)
1:5
EA
ZS1.2 ; 24kV
M | A2 | D | 1 | 1

ABB Calor Emag Mittelspannung GmbH

Kabelanschluß-System 2500A
Cable connecting bar system 2500A

GCE8012050

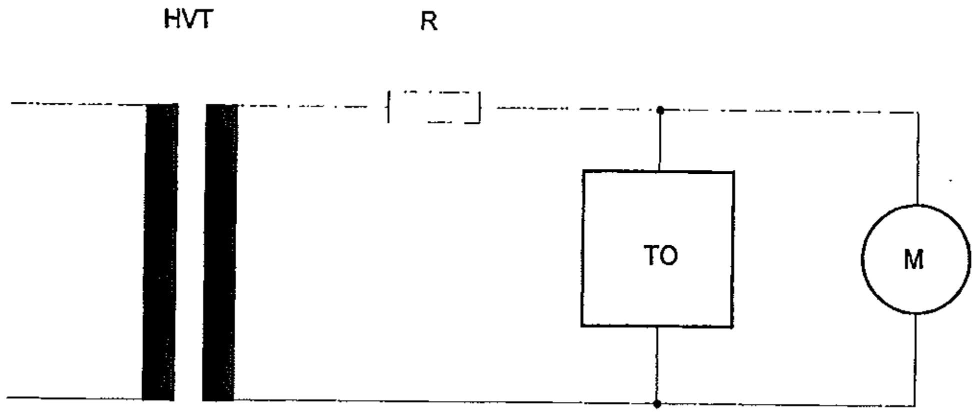


Firma Dep. Name
DECMS EG Perschau
The test object corresponds to this drawing
Date Signature
26.11.00

This document / drawing has not been checked in detail by the testing authority

	Feldbreite	Maß A	Maß B
ZS1, 24kV = 1250A = 25kA	800	72	437,5
ZS1, 24kV = 2000A = 25kA	1000	72	437,5
ZS2, 24kV = 1250A = 25kA	800	72	437,5
ZS2, 24kV = 1250A = 25kA	1000	72	437,5

Technical Data of Test Circuit
Power Frequency Voltage



Technical Data

HVT - High Voltage Test Transformer: Type TEO 250/20, serial-no. 268 734, manufacturer: Meßwandler-Bau, Bamberg

Rated Voltage	260	kV
Rated Capacity	50	kVA
Short Circuit Impedance	14.6	%

TO - Test Object: ZS1.2/24 kV-type panel, 2500 A

M - Voltage Measurement: Capacitive Divider Type CM 300 (Ident-No. ELK-000994) in connection with a Peak Voltmeter Type DMI 551/Haefely (Ident-No. ELK-000989)

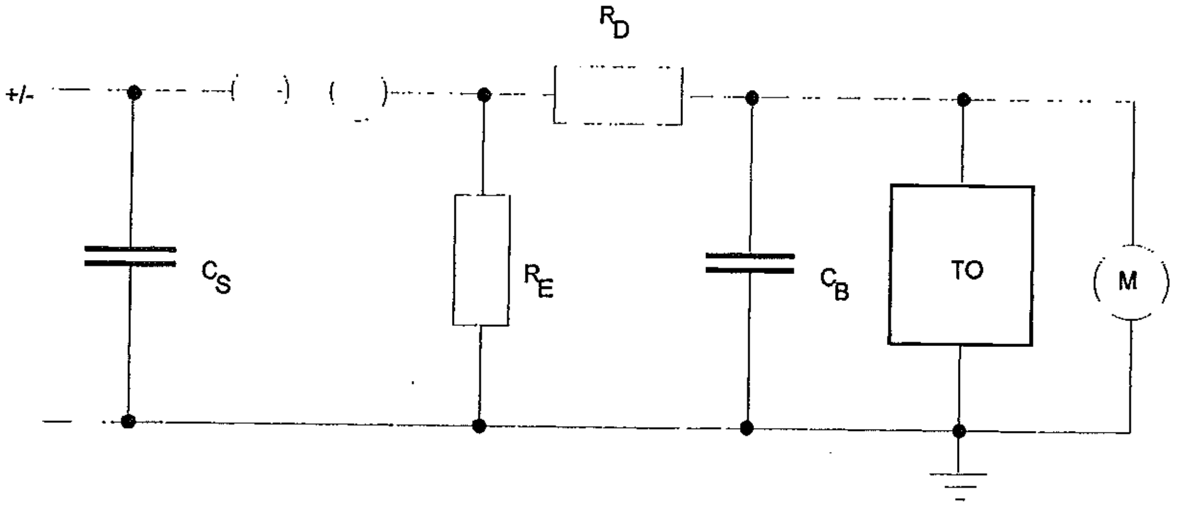
Verification of Calibration:

- Capacitive Divider (Ident-No. ELK-000994, ELK-000990, ELK-000992): calibrated on April 1998 at DEACE/LH, Calibration Report-No. 9800086.

- Peak Voltmeter Typ DMI 551 (Ident-No. ELK-000989): calibrated on April 2000 at DECMS/LK, Calibration Report No. 2000353.

Technical Data of Test Circuit

Lightning Impulse Voltage 1.2/50



Technical Data

Impulse Generator Type SGS-200/6, WO: 513809, manufacturer: Haefely

Maximum Charging Voltage	U_Σ	=	200 kV
Number of Stages	n	=	2
Surge Capacity per Stage	C_S	=	600 nF
Load Capacitance	C_B	=	1000 pF
Damping Resistance	R_D	=	$R_{SI} + R_{SE}$
Internal Front Resistance per Stage	R_{SI}	=	20 Ω
External Front Resistance	R_{SE}	=	300 Ω
Discharge Resistance	R_E	=	2 R_P
Tail Resistance per Stage	R_P	=	115 Ω

TO - Test Object: ZS1.2/24 kV-type panel, 2500 A

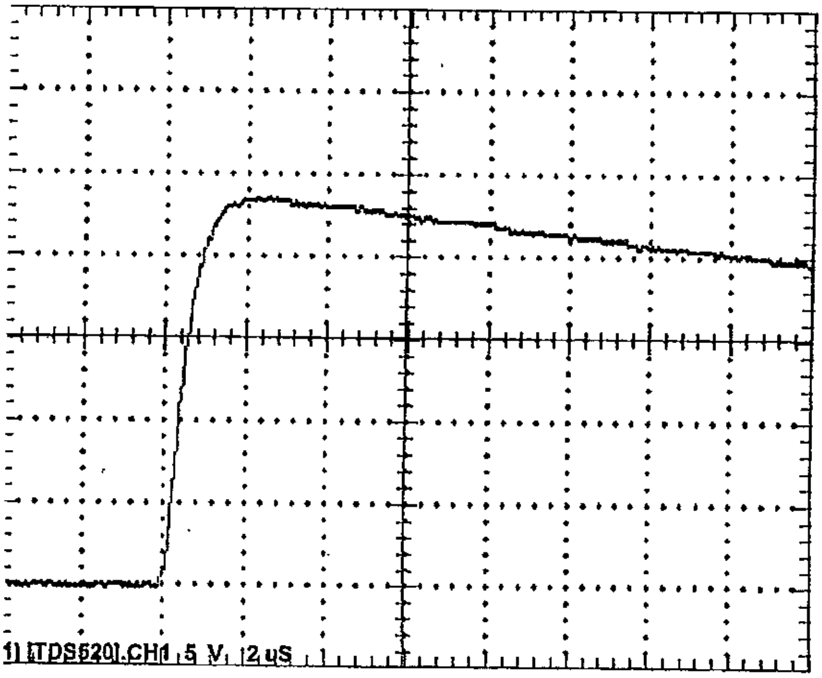
M - Voltage Measurement: Capacitive Divider Type CS 200 SPZ (Ident-No. ELK-000893, ELK-000894) in connection with a Peak Voltmeter Type DMI 551/ Haefely (Ident-No. ELK-000989) and Oscilloscope Type TDS520 (Ident-No. ELK-000545).

Verificatin of Calibration:

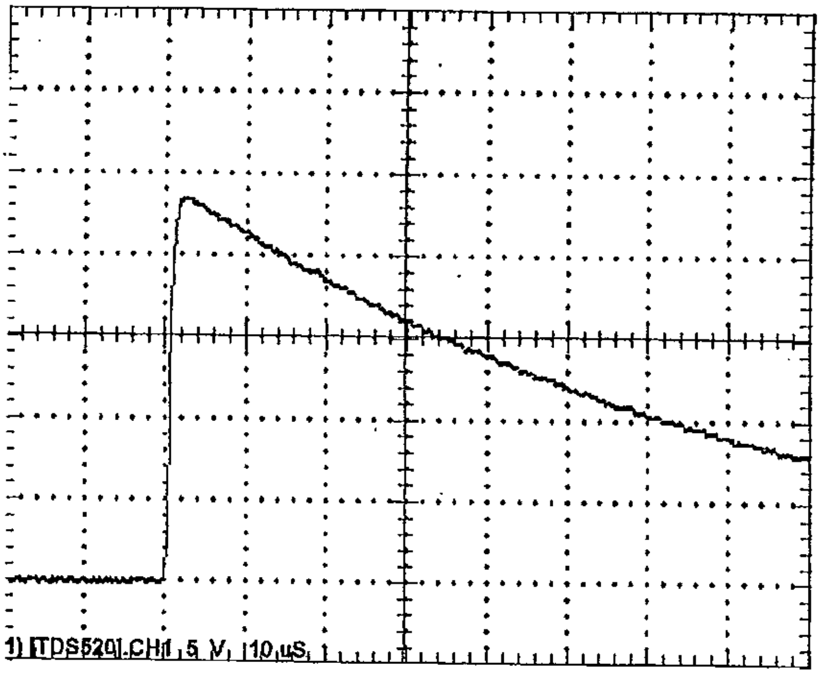
- Capacitive Divider (Ident-No. ELK-000893, ELK-000894, ELK-000922, ELK-001074): Calibrated in February 1998 at FGH Mannheim, FGH-Calibration-Report-No. 050 DKD-K-15901 98-02.
- Peak Voltmeter Type DMI 551 (Ident-No. ELK-000989): Calibrated in Mai 2000 at FGH Mannheim, FGH-Calibration-Report-No. 073 DKD-K-15901 00-05.
- Oscilloscope Type TDS520 (Ident-No. ELK-000545): calibrated in March 2000 at DECMS/LK, Calibration-Report-No. 2000297.

Lightning Impulse Voltage with the Test Object connected

(Standard Value: 1.2 ± 30 % / 50 ± 20 % / peak ±3 %)



T$_1$ = 1.26 µs



T$_2$ = 51.0 µs

Atmospheric Conditions during Tests

Date of test: 28th November 2000

IEC17A/567/Q: Corrigendum to subclause 6.2.1 of IEC60694, 2000-01

(Indices: ~ power frequency voltage; + positive lightning impulse voltage; - negative lightning impulse voltage)

Input data			Correction factors		calculated	applied
air temperature t:		19.5 °C	air density correction factors	$k_{1\sim}$:	1.006	-
air pressure b:		1017 hPa		k_{1+}:	1.006	-
air humidity h:		7.212 g/m^3		k_{1-} :	1.006	-
50% disruptive-discharge voltages	$U_{B\sim}$:	kV	air humidity correction factors	$k_{2\sim}$:	0.954	-
	U_{B+}:	kV		k_{2+}:	0.962	-
	U_{B-}:	kV		k_{2-} :	0.962	-
minimum discharge path L:		m	atmospheric correction factors	$K_{t\sim}$:	0.960	0.960
				K_{t+} :	0.967	0.967
				K_{t-} :	0.967	0.967

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and against shutter.

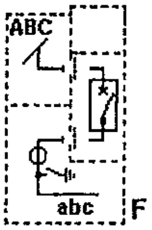
Date of test: 28th November 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: For further details see the entry in column 'Condition'

Front time T_1: 1.26 µs Time to half-value T_2: 51.0 µs Test frequency f: 50 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m^3.

Test Arrangement 1: 			Applied power frequency voltage ~ kV	Result
Condition	Voltage applied to	Earthed	Applied lightning impulse voltage ± kV	Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in test position, shutters closed. Infeed of the test voltage at the led-out busbar right hand.	A	BCabcF	50 +125 -125	1 minute/0 15/0 15/0
	B	ACabcF	50 +125 -125	1 minute/0 15/0 15/0
	C	ABabcF	50 +125 -125	1 minute/0 15/0 15/0
Vacuum circuit-breaker in test position, shutters closed. Infeed at the cable connecting bar in the cable compartment.	a	ABCbcF	50 +125 -125	1 minute/0 15/0 15/0
	b	ABCacF	50 +125 -125	1 minute/0 15/0 15/0
	c	ABCabF	50 +125 -125	1 minute/0 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and across open switching device.

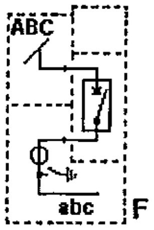
Date of test: 28th November 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: For further details see the entry in column 'Condition'

Front time T_1: 1.26 µs Time to half-value T_2: 51.0 µs Test frequency f: 50 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test arrangement 2: 			Applied power frequency voltage ~ kV	Result
Condition	Voltage applied to	Earthed	Applied lightning impulse voltage ± kV	Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and open. Infeed of the test voltage at the led-out busbar right hand.	A	BCabcF	50 +125 -125	1 minute/0 15/0 15/0
	B	ACabcF	50 +125 -125	1 minute/0 15/0 15/0
	C	ABabcF	50 +125 -125	1 minute/0 15/0 15/0
Vacuum circuit-breaker in service position and open. Infeed of the test voltage at the cable connecting bar in the cable compartment.	a	ABCbcF	50 +125 -125	1 minute/0 15/0 15/0
	b	ABCacF	50 +125 -125	1 minute/0 15/0 15/0
	c	ABCabF	50 +125 -125	1 minute/0 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase and phase-to-ground.

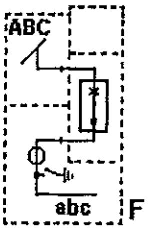
Date of test: 28th November 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand.

Front time T_1: 1.26 µs Time to half-value T_2: 51.0 µs Test frequency f: 50 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m^3.

Test Arrangement 3: 			Applied power frequency voltage ~ kV	Result
Condition	Voltage applied to	Earthed	Applied lightning impulse voltage ± kV	Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and closed	Aa	BCbcF	50 +125 -125	1 minute/0 15/0 15/1
	Bb	ACacF	50 +125 -125	1 minute/0 15/0 15/0
	Cc	ABabF	50 +125 -125	1 minute/0 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

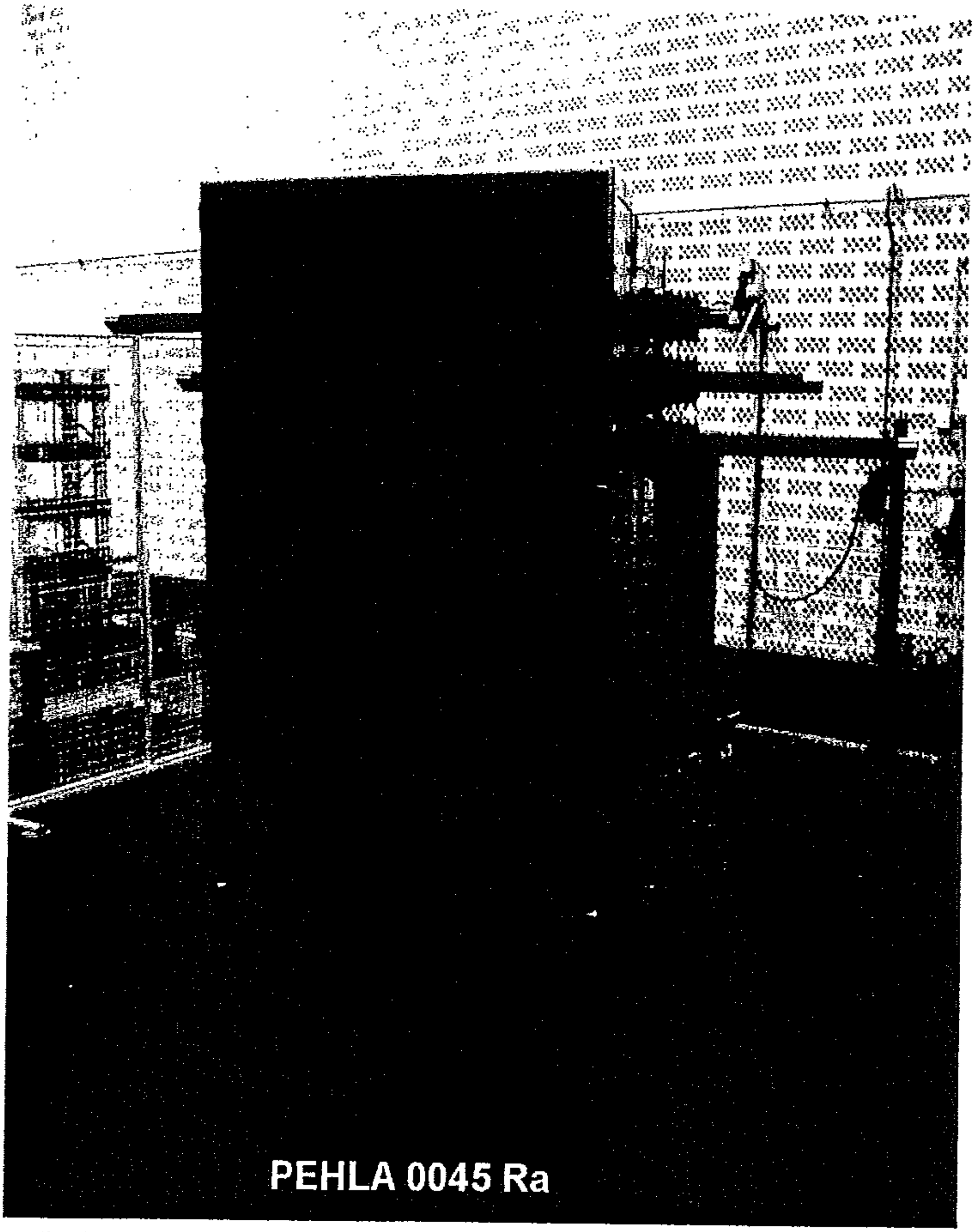


Fig. 1: ZS1.2 / 24 kV-type panel

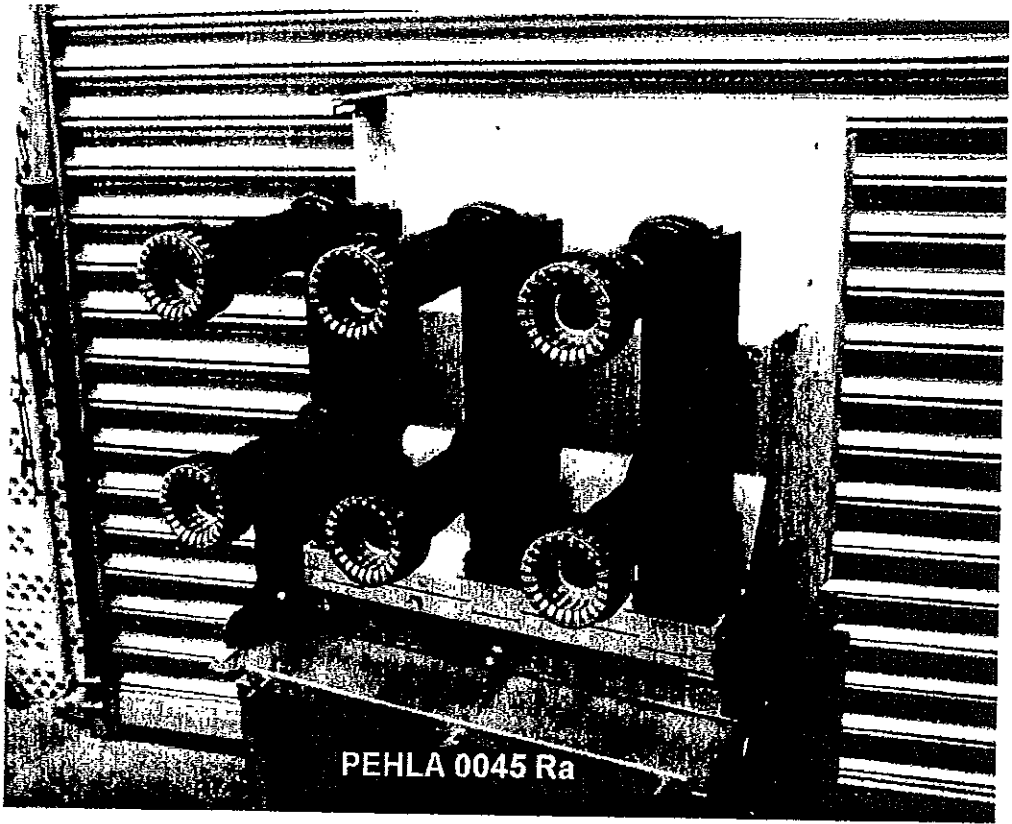


Fig. 2: Vacuum circuit-breaker type VD4P 2420-25

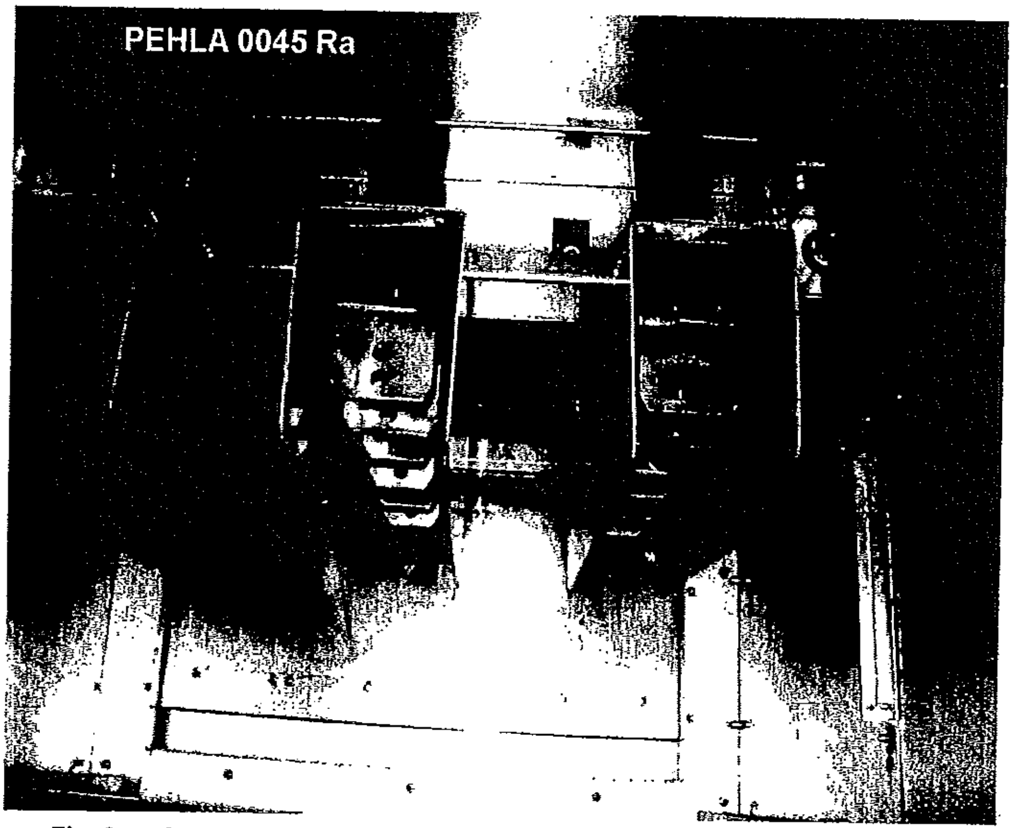


Fig. 3: Cable compartement

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the SHORT-CIRCUIT TESTING LIAISON (STL)

Test Document

Report No.: 0511Ra **Copy No.:** 1 **Contents:** 72 **Sheets**

Test object: Vacuum circuit-breaker type VD4/P 24.06.20 p275 in metal-enclosed air-insulated switchgear type UniGear ZS1, 1000 mm width

Designation: VD4/P 24.06.20 p275 in UniGear ZS1 (1000 mm width)
Rated voltage: 24 kV Rated normal current: 630 A Rated frequency: 50 / 60 Hz
Rated short-circuit breaking current: 20 kA

Manufacturer: ABB P.T. S.p.A.

Client: ABB P.T. S.p.A.

Testing station: PEHLA-Testing Laboratory Ratingen

Date of test: 10th February, 09th and 10th March 2005

Applied test specifications:

The tests have been carried out in full compliance with the below mentioned standards.
Test procedure and test parameters were strictly according to:
IEC 62271-200 / 1st Ed. / 2003-11, Clauses 6.6 and 6.101
IEC 60694 / Ed. 2.2 / 2002-01, Clause 6.6
IEC 62271-100 / Ed. 1.1 / 2003-05, Clause 6.106
According to STL Objectives and Operating Principles PEHLA issues a Test Document following exclusively the above mentioned test specifications and the STL Guides wherever applicable.

Tests performed:

Three-phase short-time withstand current and peak withstand current test of the main circuit.
Three-phase making and breaking capacity test based on 20.0 kA at 24 kV comprising the basic test duties T10, T30, T60, T100s and T100a (dc-component of 35 %).
No-load operations and measurement of the resistance of the main circuit before and after the tests.
Power frequency withstand voltage test at 50.0 kV – 1 min before and after the tests as a condition check.

Test results:

The above mentioned vacuum circuit-breaker in metal-enclosed air-insulated switchgear passed the short-time withstand current and peak withstand current test and the three-phase making and breaking capacity test successfully.

GESELLSCHAFT FÜR ELEKTRISCHE
HOCHLEISTUNGSPRÜFUNGEN

Management Committee

Technical Committee

Mannheim, 20th July 2005

The test results relate only to the items tested.
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03PE0402

Deutscher Akkreditierungs Rat
DAR
DAT-P-032/93

Notes

Accreditation

The PEHLA-Testing Laboratory Ratingen has been approved by the DATech (German accreditation body for technology) according to EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P032/93).

STL-Member

PEHLA is founder member of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (UK), CESI (IT), ESEF (FR), KEMA (NL), SATS (NO; SE, FI), STLNA (US, CA) and JSTC (JP). In the framework of EC, STL (EU) has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Type Test Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

A Test Confirmation

is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.

Uncertainty of the measurement systems

The PEHLA - Testing Laboratories apply the PEHLA Guide No. 12 for determining the uncertainties of measurement, based on ENV 13005 (Guide to the expression of uncertainly in measurement). As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.

Addresses

Office: PEHLA-Geschäftsstelle
Hallenweg 40
68219 Mannheim
Germany
Internet: www.pehla.com

Testing Station: PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen
Germany

Manufacturer: ABB P.T. S.p.A.
Via Friuli, 4
24044 Dalmine (BG)
Italy

Client: ABB P.T. S.p.A.
Via Friuli, 4
24044 Dalmine (BG)
Italy

Table of Contents

List of Test Participants

Representatives of Technical Committee:

Mr. Klaus Niemeyer	PEHLA-Testing Laboratory Berlin-Siemensstadt, Germany
Mr. Joachim Oemisch	PEHLA-Testing Laboratory Berlin-Siemensstadt, Germany
Dr. Thomas Ebke	PEHLA-Testing Laboratory Ratingen, Germany

Test Engineer / Test Operator:

Mr. Joachim Köhler	PEHLA-Testing Laboratory Ratingen, Germany
Dr. Thomas Ebke	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of Client:

Mr. Stefano Magoni	ABB P.T. S.p.A., Dalmine, Italy

Further Participants:

Mr. Frank Idaszek	PEHLA-Testing Laboratory Ratingen, Germany

Technical Data of Test Object
Switchgear

Test object:	Metal-enclosed air-insulated switchgear.
Designation:	UniGear ZS1
Manufacturer:	ABB P.T. S.p.A., Via Friuli, 4, 24044 Dalmine (BG), Italy
Serial No.:	-
Year of manufacture:	2004
Drawing No.:	See sheet 7

Ratings assigned by the manufacturer:

Rated voltage	24	kV	
Rated normal current	630	A	
Rated frequency	50/60	Hz	
Rated lightning impulse withstand voltage	125	kV	
Rated switching impulse withstand voltage	-	kV	
Rated power-frequency withstand voltage	50	kV	
Rated peak withstand current	63/65	kA	
Rated short-time withstand current	25	kA	
Rated duration of short-circuit	3	s	
Insulating medium	-		
Rated filling pressure for insulation	-	MPa	abs. at 20 °C
Minimum functional pressure for insulation	-	MPa	abs. at 20 °C

Permissible values for internal arc faults:

Peak current	63/65	kA
Short-circuit current	25	kA
Duration of short-circuit	1	s

Further data: -

Essential characteristics and installed devices: -

Technical Data of Test Object

Circuit-Breaker

Test object:	Vacuum circuit-breaker
Designation:	VD4/P 24.06.20
Manufacturer:	ABB P.T. S.p.A., Via Friuli, 4, 24044 Dalmine (BG), Italy
Serial No.:	1VC1AE00038562
Year of manufacture:	2004
Serial No. of drive:	-
Drawing No.:	See sheet 7

Ratings assigned by the manufacturer:

Rated voltage	24	kV	
Rated normal current	630	A	
Rated frequency	50/60	Hz	
Rated lightning impulse withstand voltage	125	kV	
Rated switching impulse withstand voltage	-	kV	
Rated power-frequency withstand voltage	50	kV	
Rated peak withstand current	50/52	kA	
Rated short-time withstand current	20	kA	
Rated duration of short-circuit	3	s	
Rated short-circuit breaking current	20	kA	
DC component of the rated short-circuit breaking current	35	%	
Rated short-circuit making current	50/52	kA	
Rated transient recovery voltage	41	kV	
Rate of rise of transient recovery voltage	0.47	kV/µs	
First-pole-to-clear factor	1.5		
Rated operating sequence	O - 0.3 s - CO - 15 s - CO		
Arc extinguishing medium	vacuum		
Rated filling pressure for operation	-	MPa	abs. at 20 °C
Minimum functional pressure for operation	-	MPa	abs. at 20 °C
Insulating medium	-		
Rated filling pressure for insulation	-	MPa	abs. at 20 °C
Minimum functional pressure for insulation	-	MPa	abs. at 20 °C
Driving mechanism (type)	spring charged by motor		
Number of poles	3		
Number of units per pole	1		
Rated opening time	30 – 60	ms	
Rated closing time	50 – 80	ms	
Rated supply voltage of opening device	110	V	d.c.
Rated supply voltage of closing device	110	V	d.c.
Rated supply voltage of auxiliary circuits	110	V	d.c.
Rated frequency of supply voltage	-	Hz	

Further data:

Type and Serial No. of Poles: P4 with VG4, L1: EP00013111, L2: EP00013094, L3: EP00013173

Essential characteristics: -

List of Identified Drawings

The manufacturer has submitted to the testing laboratory drawings and other data containing sufficient information to unambiguously identify by type the essential details and parts of the test object presented for test.

The drawings have been stamped and signed by the manufacturer in order to guarantee that the drawings or data schedules truly represent the test object to be tested.

Further these drawings have been stamped and signed by PEHLA representatives and are kept

☐ at the client.

☒ with the test documents at the test laboratory.

The testing laboratory has checked that drawings and data schedules adequately represent the essential details and parts of the test object to be tested, but is not responsible for the accuracy of the detailed information.

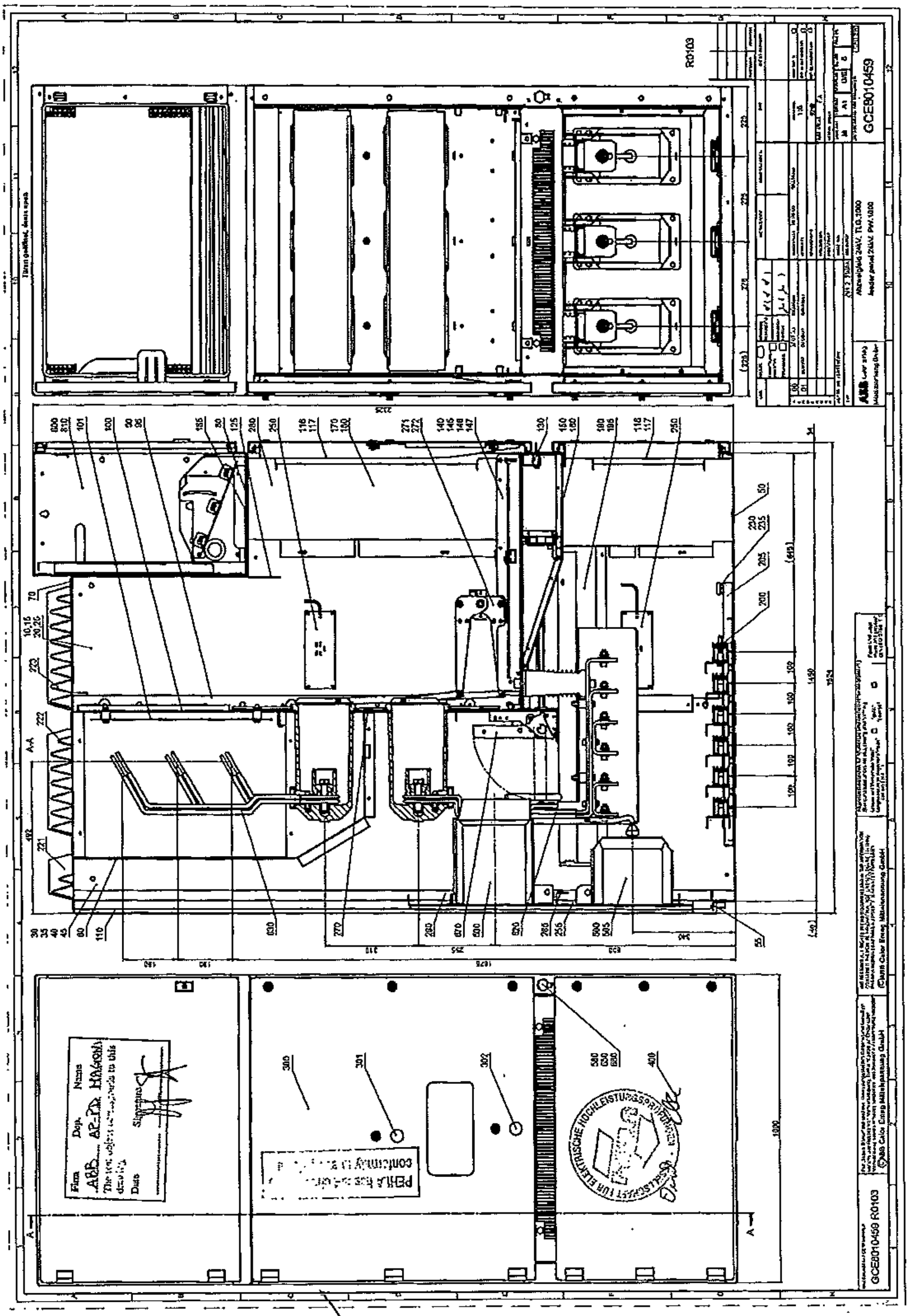
The drawing(s) contained in this document are identical with the checked, stamped and signed drawings.

Drawing No.	Rev.	P/D *)	Title	Additional remarks
GCE8010459 R0103	01	D	Abzweigfeld 24kV, TLG.1000 Feeder panel 24kV, PW.1000	Included in the Test Report
TN 7414	--	D	Interruttore in Vuoto Tipo Vacuum Circuit Breaker Type VD4/P 24kV 630-1250A	Included in the Test Report
GCE8012502 R0103	01	D	MONTAGEPLATTE H=310, KONTAKT 35 Mounting plate H=310, contact 35	-
GCE8685778 P0121	03	D	Kontaktstift	-
N 510509 Gr. 810	--	P	Tabella Materiali N 510509	-
510509 Gr. 810	--	D	Completamento Interruttore C.B. Completion	-
N 1VCR003288 G0015	--	P	Tabella Materiali N 1VCR003288G	-
1VCR003288 G0015	--	D	Struttura con poli Frame with Poles	-
N 1VCR003324 G0015	--	P	Tabella Materiali N 1VCR003324G	-
1VCR003324 G0015	--	D	Interuttore Base Base Breaker	-
N 1VCR003321 G0003	--	P	Tabella Materiali N 1VCR003321G	-
1VCR003321 G0003	--	D	Commando con Albero Operating Mechanism with Shaft	-
N 510508 Gr. 802	--	P	Tabella Materiali N 510508	-
510508 Gr. 802	--	D	Montaggio Passanti e Tulipani Bushing and Tulip Mounting	-
GCE7004730 R0104	11	D	Pol, vst. 24kV 1250A Pole complet 24kV 1250A	-

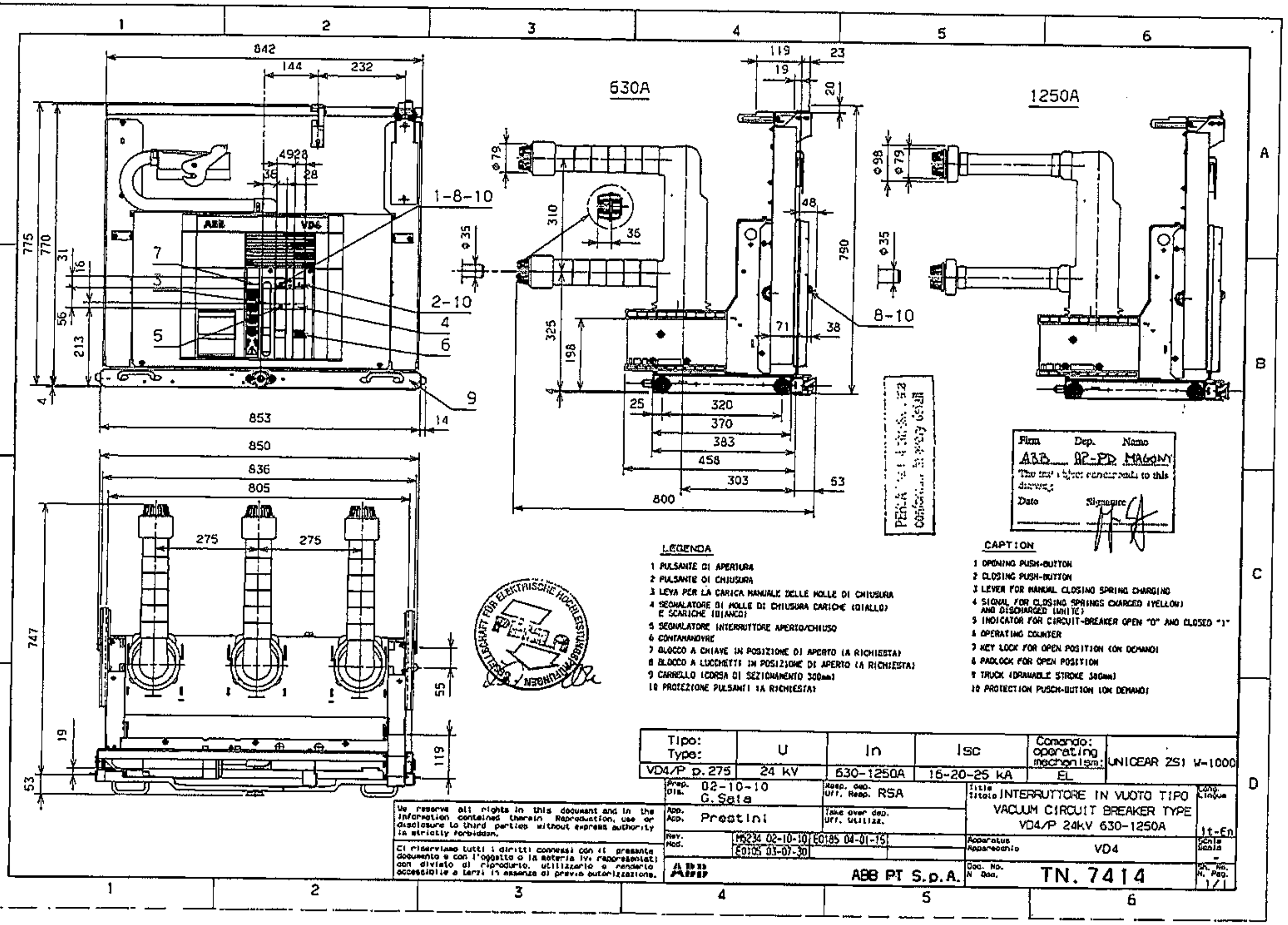
*) P: Parts list, D: Drawing

Remarks: -

Drawing
GCE8010459R0103



Drawing
TN.7414



12PE0402

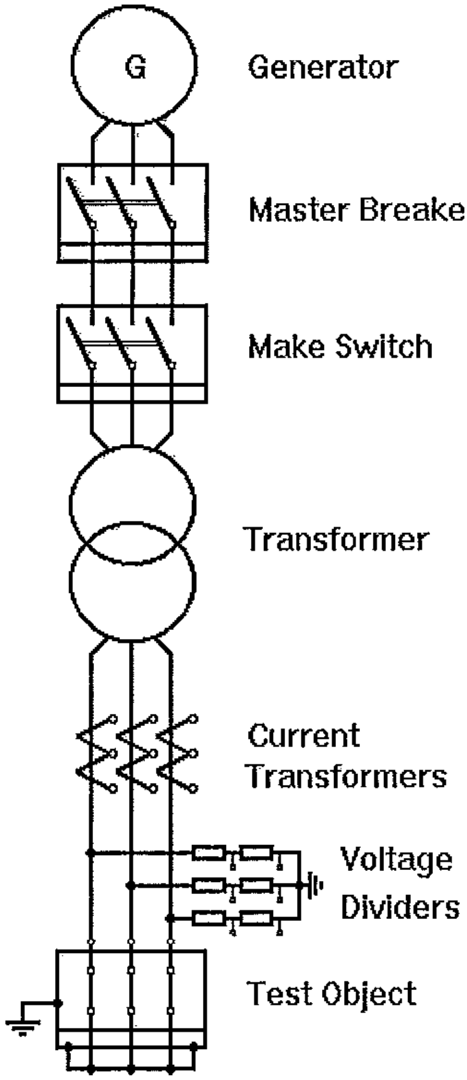
Technical Data of Test Circuits

Short-Time Withstand Current and Peak Withstand Current Tests

Test performed		STC	-	-	-
Test No. PEHLA 0511Ra		03 - 04	-	-	-
Circuit diagram	Sheet No.	11	-	-	-
Current circuit		-	-	-	-
Number of phases		3	-	-	-
Power frequency	Hz	50	-	-	-
Power factor		< 0.15	-	-	-
Earthing conditions		-	-	-	-
Generator / System		earthed via 5 kΩ	-	-	-
Transformer		not earthed	-	-	-
Short-circuit point		earthed	-	-	-
Test object		earthed	-	-	-
Test object (test values)		-	-	-	-
Number of phases		3	-	-	-
Measurement		-	-	-	-
Voltage measurement		Dividers 80 kΩ / 1.1 kΩ	-	-	-
Current measurement		Transf. 50 kA / 5 A	-	-	-

Remarks: -

Circuit Diagram
Test Circuit for Three-Phase Tests
Peak Withstand Current and Short-Time Withstand Current Tests



Technical Data of Test Circuit

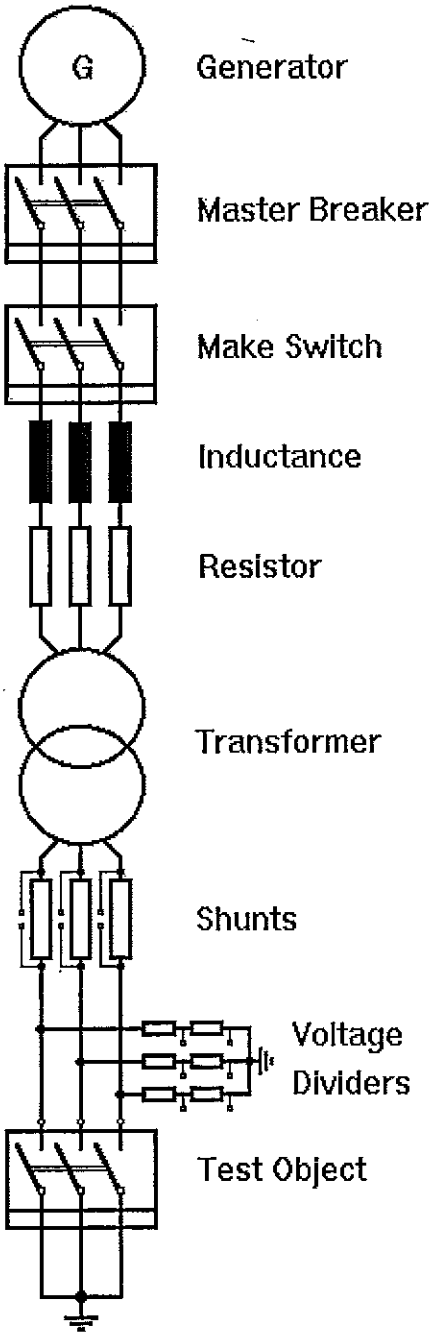
Short-Circuit Direct Test

Test performed		T30		T60		T100		T10	
Test No. PEHLA 0511Ra		07-08		09-12		13-28		29-30	
Circuit diagram (test circuit)	see sheet	13		13		13		13	
Test object . Rated voltage	kV	24		24		24		24	
Rated frequency	Hz	50		50		50		50	
Short-circuit breaking current	kA	6.00		12.0		20.0		2.00	
Units under test		-		-		-		-	
Voltage distribution	%	-		-		-		-	
Number of phases (test circuit)		3		3		3		3	
Power factor (test circuit)		≤ 0.15		≤ 0.15		≤ 0.15		≤ 0.15	
Frequency (test circuit)	Hz	50		50		50		50	
Earthing conditions Generator		earthed via 5 kΩ		earthed via 5 kΩ		earthed via 5 kΩ		earthed via 5 kΩ	
Transformer		not earthed		not earthed		not earthed		not earthed	
Short-circuit point		earthed		earthed		earthed		earthed	
Prospective transient recovery voltage		Required values	Tested values	Required values	Tested values	Required values	Tested values	Required values	Tested values
Evaluation of oscillogram	No.	-	prosp.	-	prosp.	-	prosp.	-	prosp.
Crest value u_c	kV	44.0	44.5	44.0	44.0	41.0	41.0	44.0	47.0
Time t_3	µs	19	38 [1]	38	38	87	80	19	66 [1]
Time delay t_d	µs	-	-	-	-	-	-	-	-
Rate of rise u_1/t_1 or u_c/t_3	kV/µs	2.32	1.17	1.16	1.16	0.47	0.51	2.32	0.71
u_1	kV	-	-	-	-	-	-	-	-
t_1	µs	-	-	-	-	-	-	-	-

Remarks: [1] Due to limitations of the test plant the time coordinate t_3 is higher than the required values.

ВЯРНО С ОРИГИНАЛА

Circuit Diagram
Test Circuit for Three-Phase Tests
Basic Short-Circuit Making and Breaking Tests



ВЯРНО С ОРИГИНАЛА

Test Results

Three-phase short-time withstand current and peak withstand current tests

Test performed:	Three-Phase Peak and Short-Time Withstand Current Tests, 52 kA / 20 kA – 3s
Date of test:	10th February 2005
Condition of test object before test:	Factory new.
Test arrangement:	Direct test circuit, circuit-breaker in air-insulated switchgear
Connections to test object:	Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra				03	04	-	-	-	-
Short-circuit current - peak		L1	kA	52.3	36.6	-	-	-	-
		L2	kA	40.6	29.8	-	-	-	-
		L3	kA	46.1	37.1	-	-	-	-
Short-circuit current - rms	First cycle	L1	kA	22.0	20.4	-	-	-	-
		L2	kA	22.7	19.9	-	-	-	-
		L3	kA	22.5	21.4	-	-	-	-
	Last cycle	L1	kA	21.0	21.1	-	-	-	-
		L2	kA	22.0	22.2	-	-	-	-
		L3	kA	21.4	21.5	-	-	-	-
	Equivalent current	L1	kA	21.0	20.6	-	-	-	-
		L2	kA	22.1	21.6	-	-	-	-
		L3	kA	21.4	21.0	-	-	-	-
	Average value		kA	21.5	21.0	-	-	-	-
	Duration of short circuit		s	0.317	3.02	-	-	-	-
Short-time current		L1	kA	-	20.6	-	-	-	-
		L2	kA	-	21.7	-	-	-	-
		L3	kA	-	21.0	-	-	-	-
	Average value		kA	-	21.1	-	-	-	-
	Duration		s	-	3.00	-	-	-	-
Emission of flame/gas/oil				no	no	-	-	-	-
Test result (P/N)				P	P	-	-	-	-

Resistance of the main circuit

Before test	L1	μΩ	26.5	-	-	-	-	-
	L2	μΩ	28.4	-	-	-	-	-
	L3	μΩ	26.9	-	-	-	-	-
After test	L1	μΩ	-	26.2	-	-	-	-
	L2	μΩ	-	27.1	-	-	-	-
	L3	μΩ	-	26.2	-	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

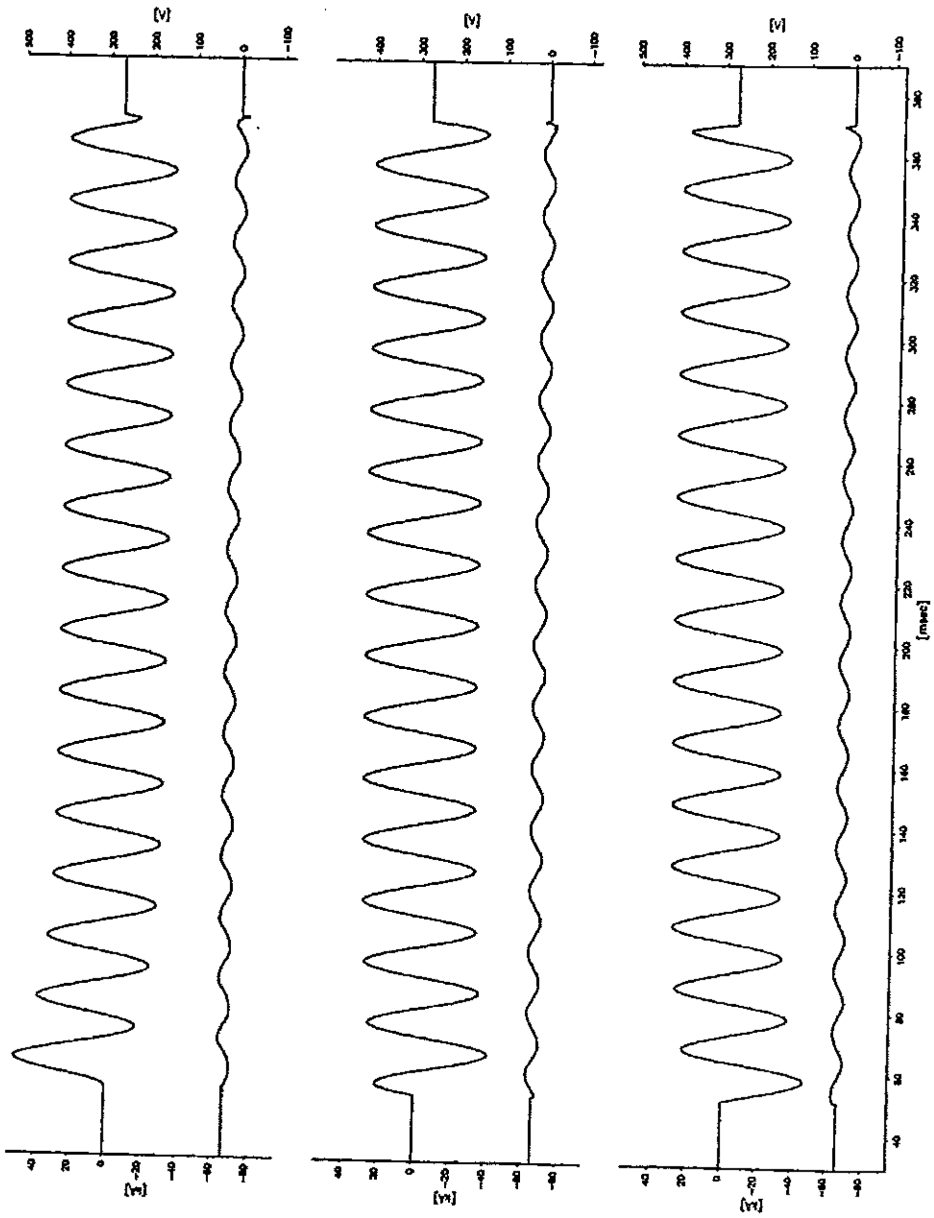
Remarks: PEHLA 0511Ra / 01: Current calibration
PEHLA 0511Ra / 02: No-load operation

Condition of test object after test: Vacuum circuit-breaker type VD4/P 24.06.20 p275 in metal-enclosed air-insulated switchgear type UniGear ZS1, 1000 mm width without visible or functional change or damage. It opened by its own mechanism energized at rated auxiliary voltage at the first attempt.

ВЯРНО С ОРИГИНАЛА

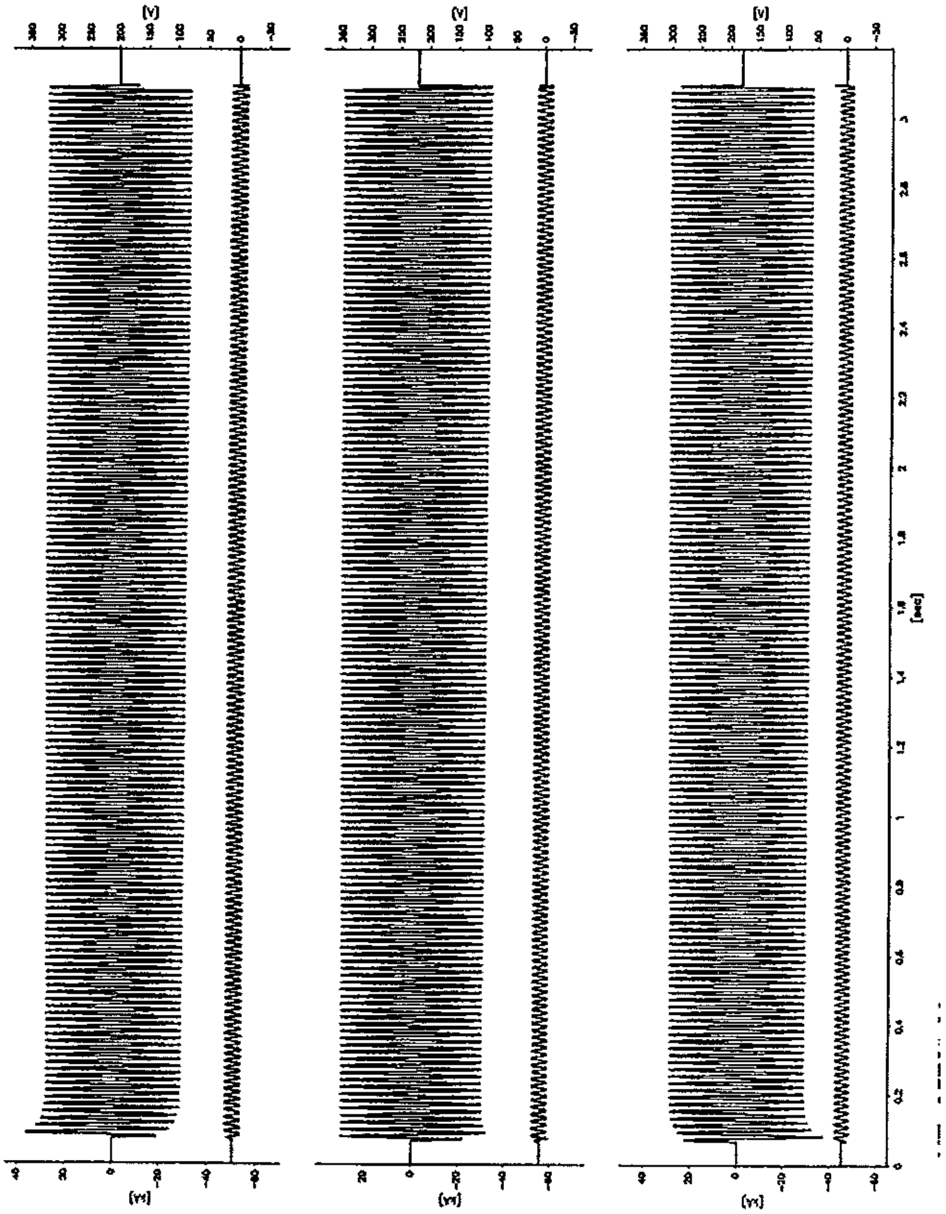
Oscillogram

PEHLA 0511Ra / 03



ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 04



Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed: Basic short-circuit making and breaking tests (T30)
Date of test: 09th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 04.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra			07		08	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	24.5	24.2	-	-	-
Making current (peak)	L1	kA	-	10.4	11.2	-	-	-
	L2	kA	-	15.1	15.5	-	-	-
	L3	kA	-	14.9	13.2	-	-	-
Breaking current (r.m.s.)	L1	kA	6.58	6.67	6.58	-	-	-
	L2	kA	6.68	6.77	6.81	-	-	-
	L3	kA	6.54	6.73	6.66	-	-	-
	Average value	kA	6.60	6.72	6.69	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.8	14.2	14.0	-	-	-
	L2	kV	14.1	14.2	14.0	-	-	-
	L3	kV	14.1	14.4	14.3	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	44.5	43.0	44.5	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	63.4	62.6	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	63.4	62.6	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	59.8	60.7	59.0	-	-	-
	Arcing time L1	ms	4.6	8.2	8.2	-	-	-
	L2	ms	9.6	7.8	3.0	-	-	-
	L3	ms	9.4	2.8	8.2	-	-	-
	Break time	ms	69.4	68.9	67.2	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

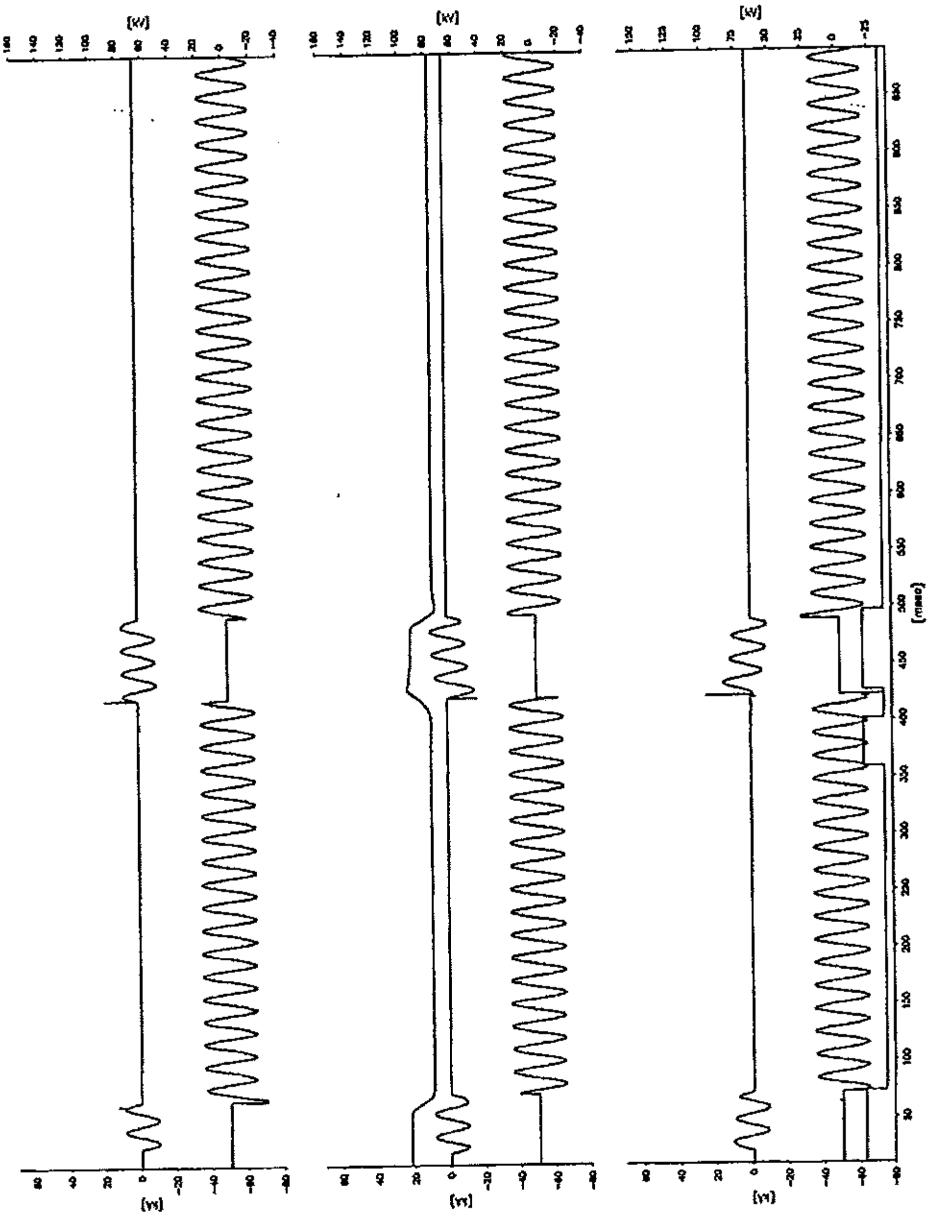
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks: PEHLA 0511Ra / 05 and 06: No-load operations

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

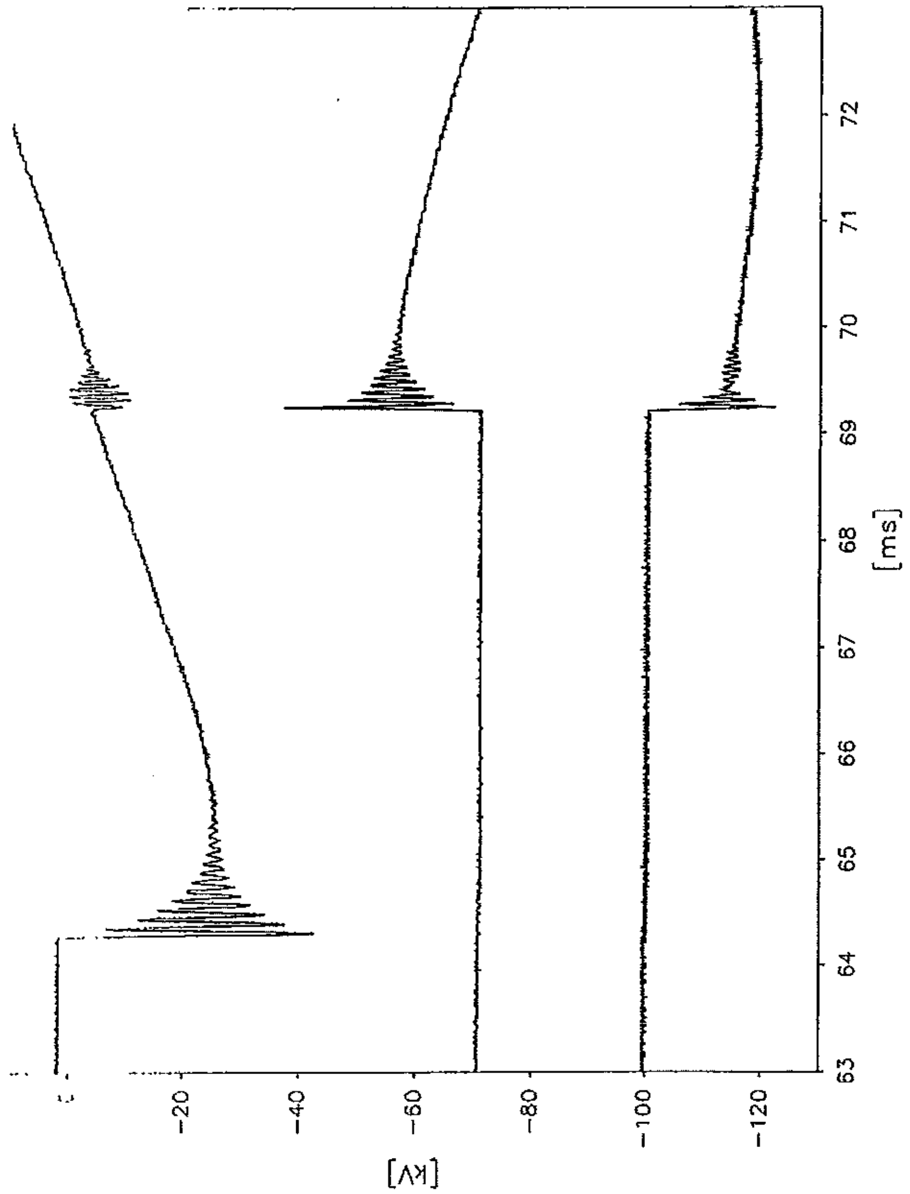
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 07



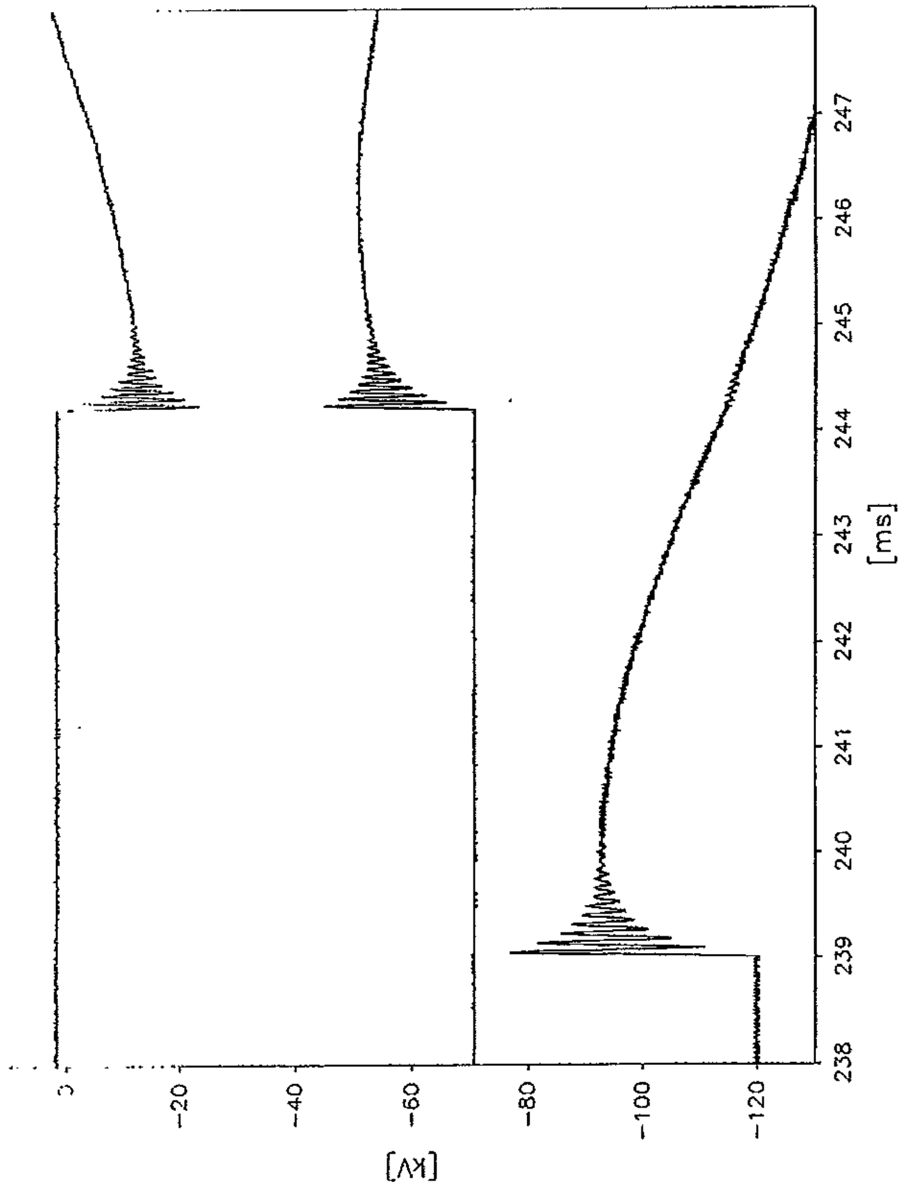
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 07



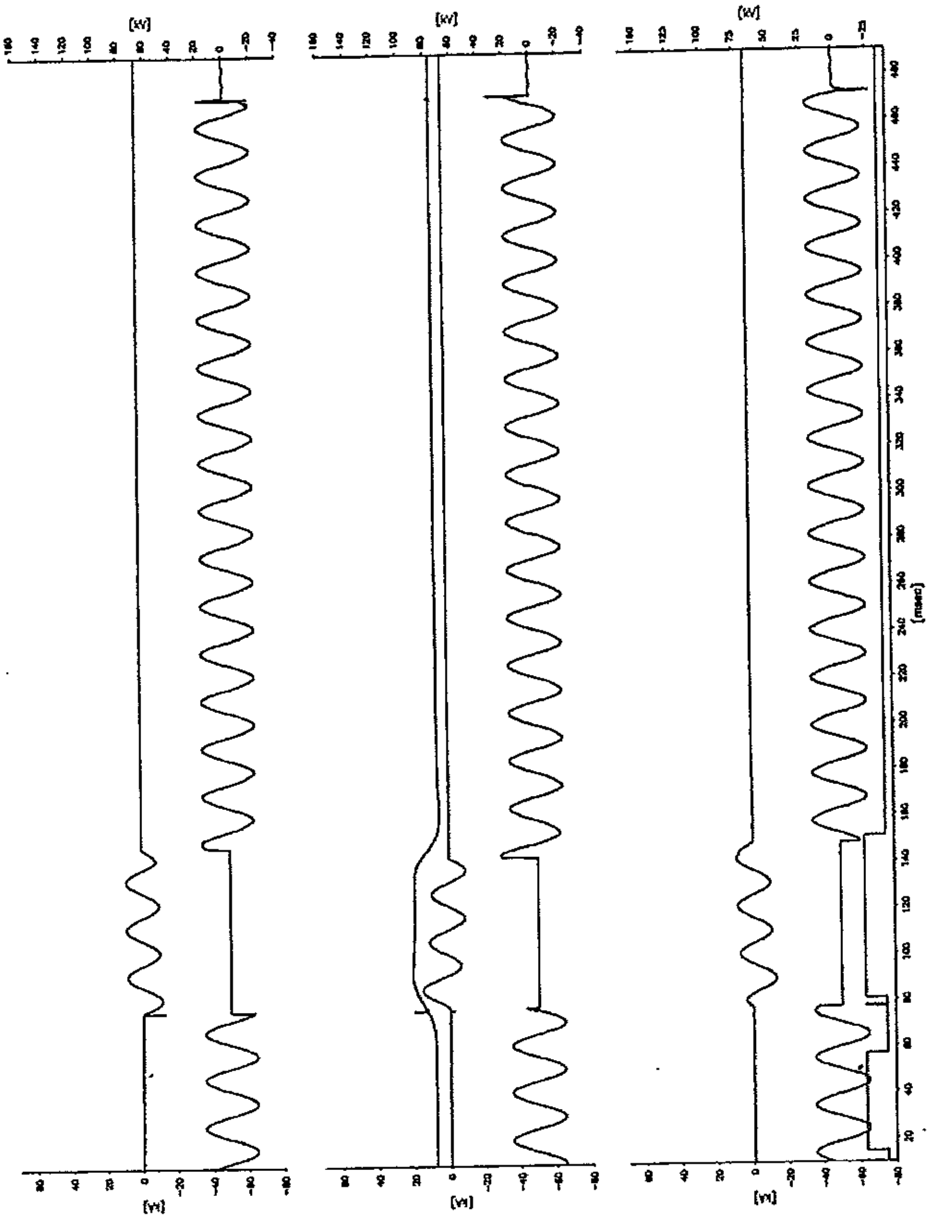
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 07



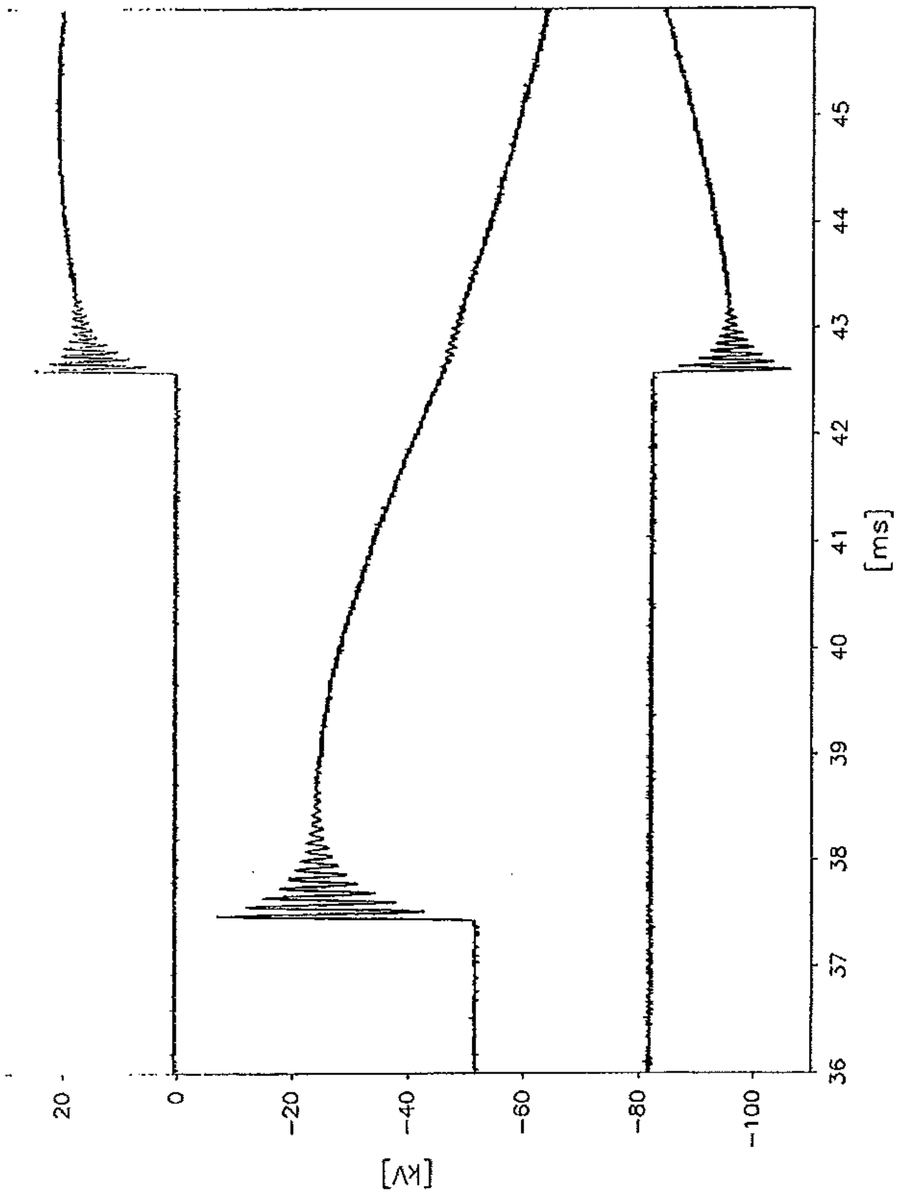
ВЯРНО С ОРИГИН

Oscillogram
PEHLA 0511Ra / 08



ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 08



ВЯРНО С ОРИГИНАЛА

Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed:	Basic short-circuit making and breaking tests (T60)
Date of test:	09th March 2005
Condition of test object before test:	As after Test Pehla 0511Ra / 08
Test arrangement:	Direct test circuit, circuit-breaker in air-insulated switchgear
Connections to test object:	Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

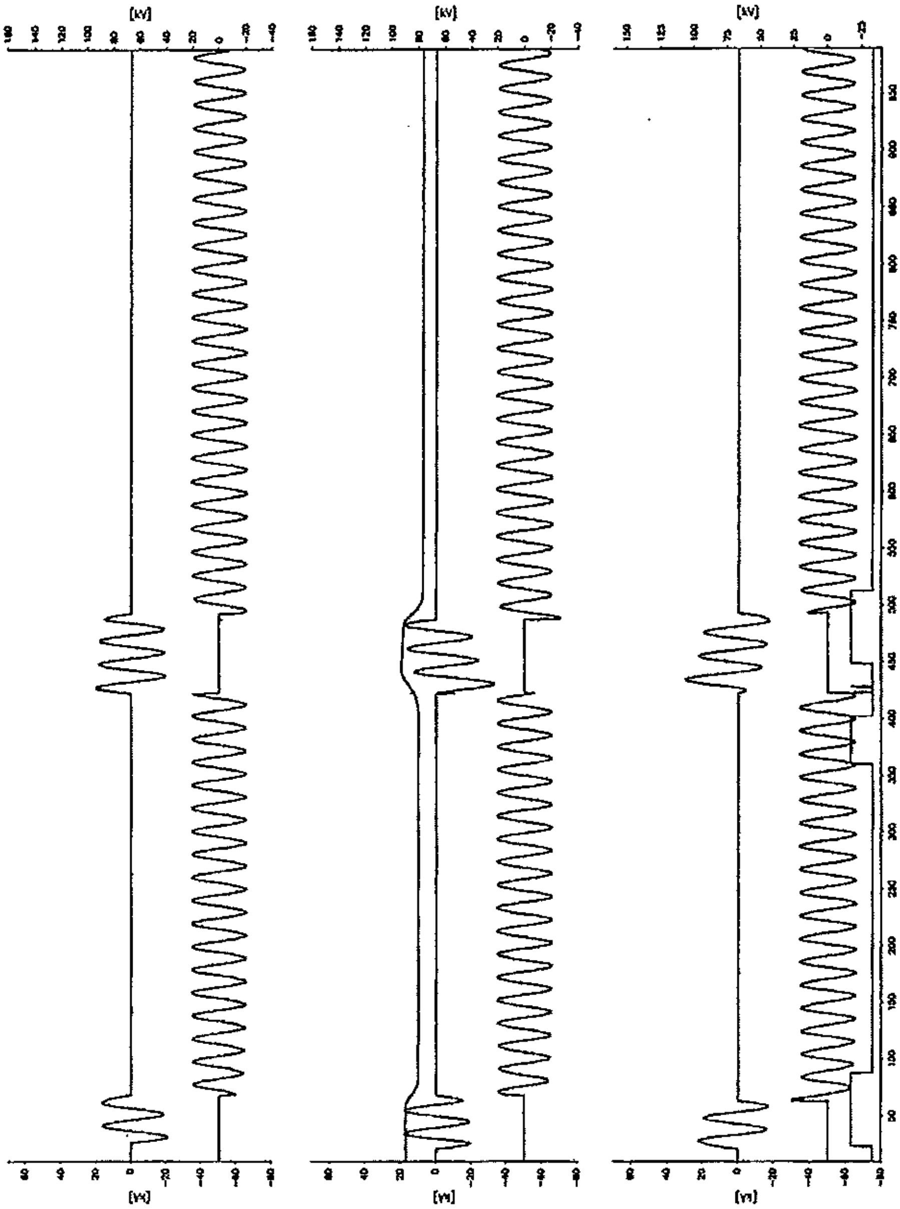
Test No. PEHLA 0511Ra			11		12	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	25.0	24.1	-	-	-
Making current (peak)	L1	kA	-	20.1	25.5	-	-	-
	L2	kA	-	32.5	32.9	-	-	-
	L3	kA	-	29.8	25.7	-	-	-
Breaking current (r.m.s.)	L1	kA	12.5	13.0	12.5	-	-	-
	L2	kA	12.8	13.5	12.8	-	-	-
	L3	kA	12.6	13.1	13.1	-	-	-
	Average value	kA	12.6	13.2	12.8	-	-	-
Recovery voltage (r.m.s)	L1	kV	14.1	14.2	13.6	-	-	-
	L2	kV	14.2	14.5	13.8	-	-	-
	L3	kV	14.2	14.8	14.4	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	41.6	42.0	42.5	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	62.8	63.5	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	62.8	63.5	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	58.6	56.5	59.4	-	-	-
	Arcing time L1	ms	7.8	7.6	8.2	-	-	-
	L2	ms	3.4	7.6	3.8	-	-	-
	L3	ms	9.0	2.6	8.8	-	-	-
	Break time	ms	67.6	64.1	68.2	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

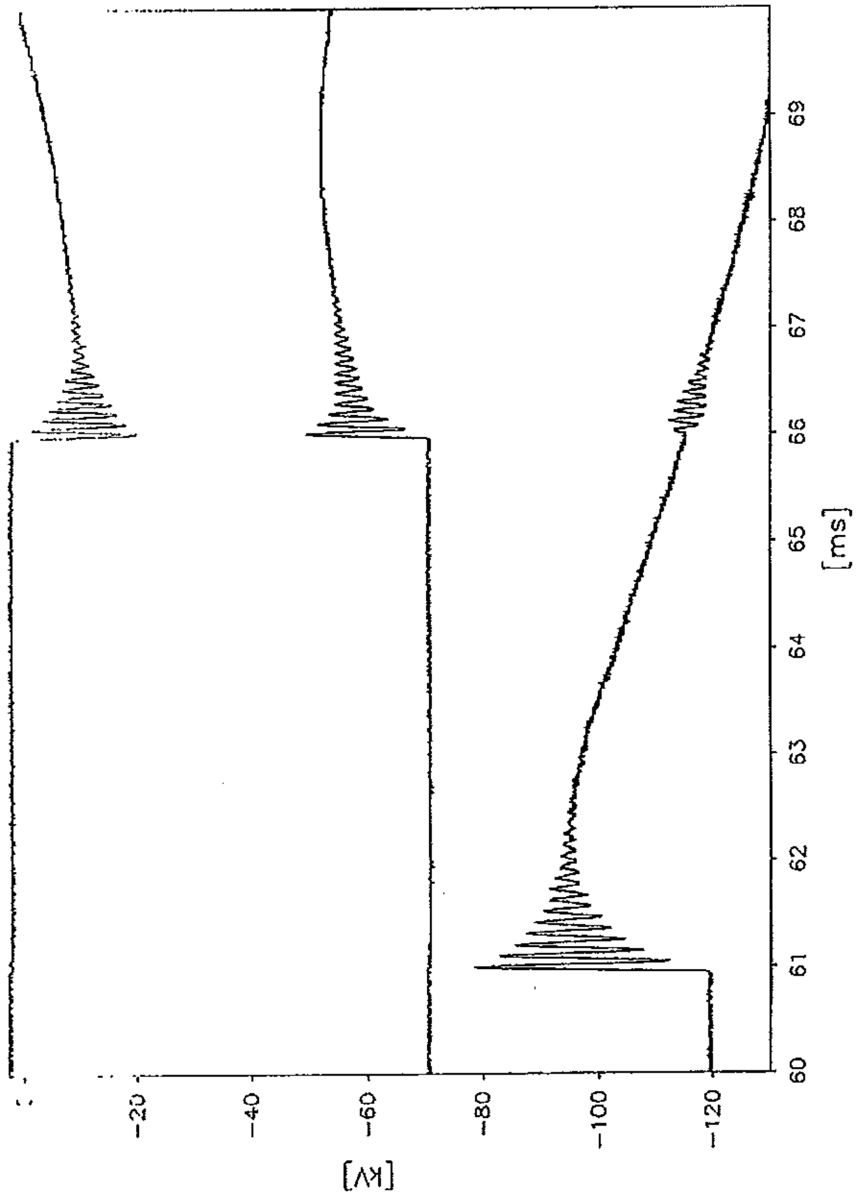
Remarks: PEHLA 0511Ra / 09 and 10: Tests with reduced values

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

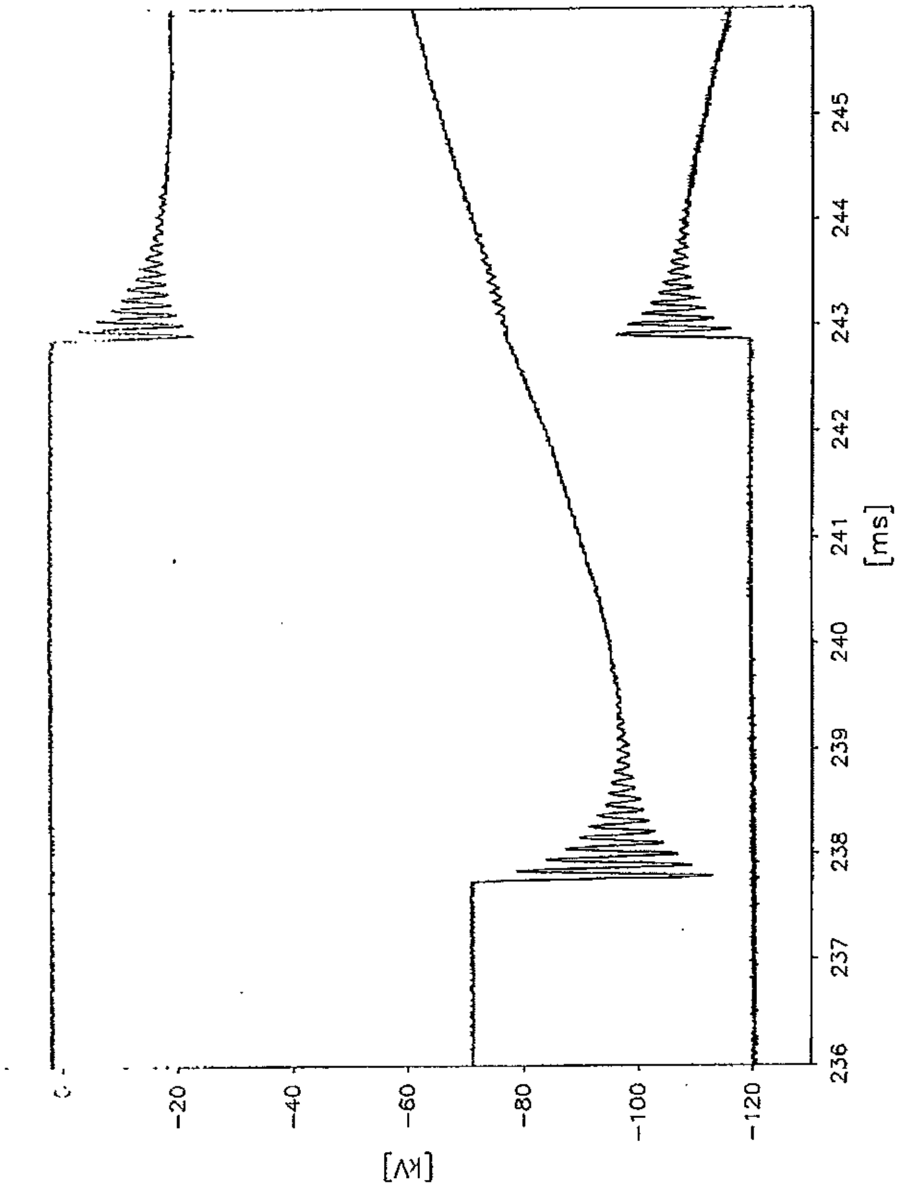
Oscillogram
PEHLA 0511Ra / 11



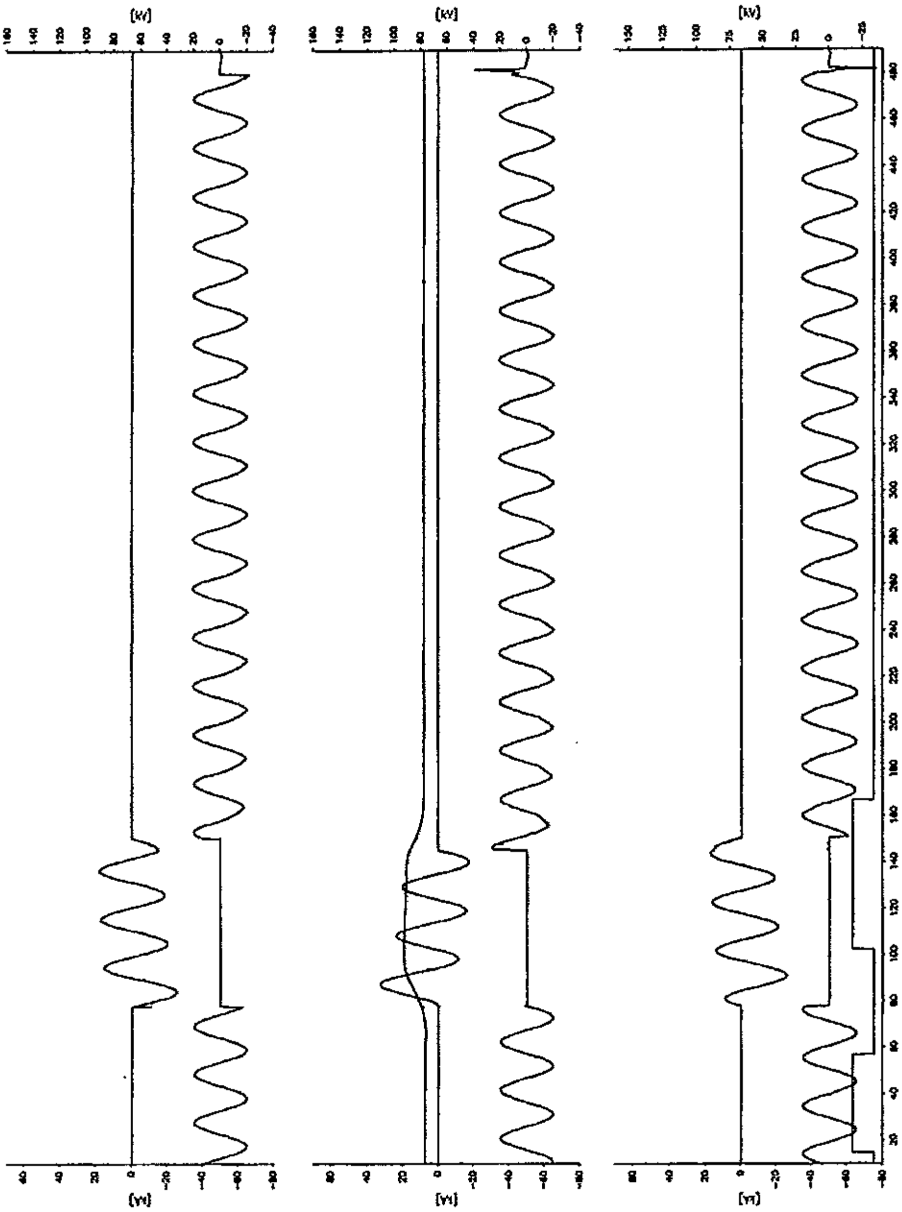
Oscillogram
PEHLA 0511Ra / 11



Oscillogram
PEHLA 0511Ra / 11

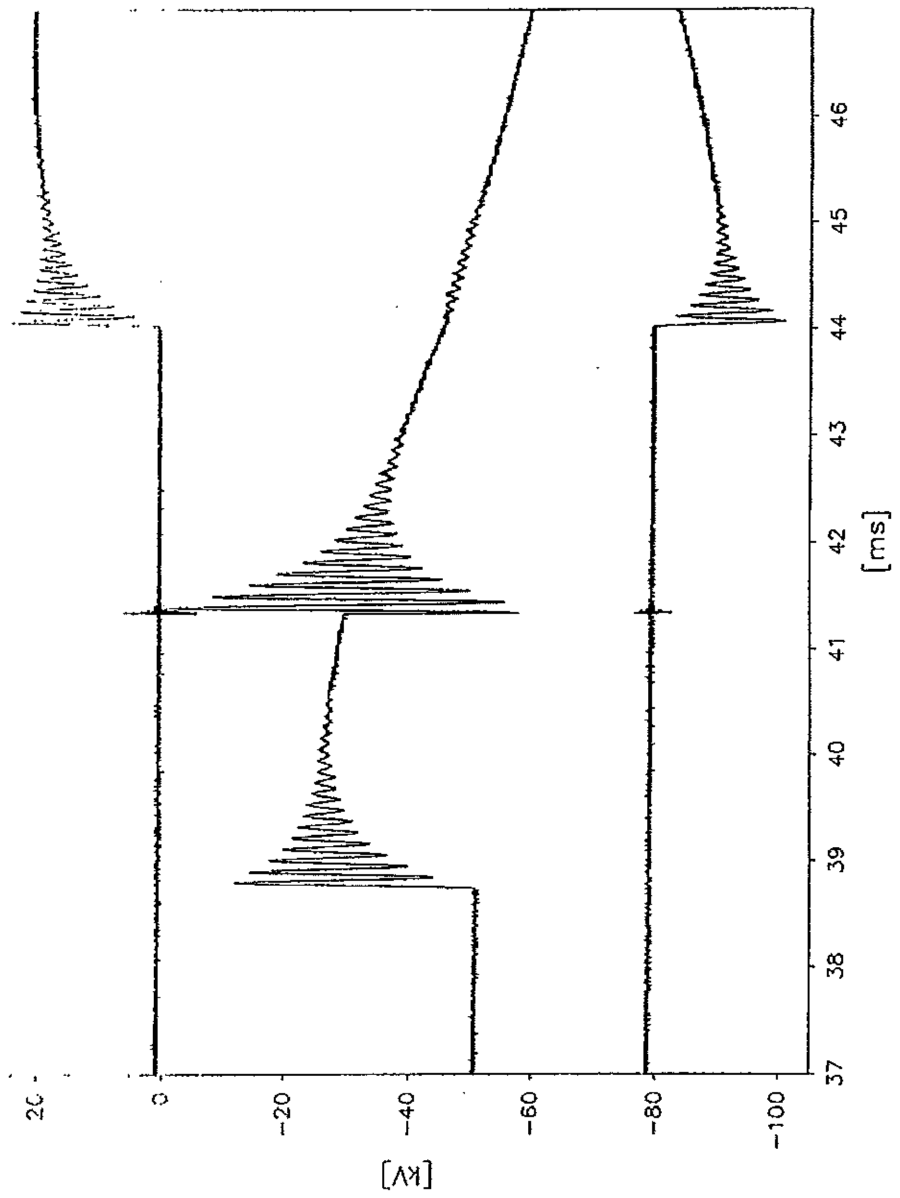


Oscillogram
PEHLA 0511Ra / 12



ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 12



ВЯРНО С ОРИГИНАЛА

Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed:	Basic short-circuit making and breaking tests (T100s)
Date of test:	09th March 2005
Condition of test object before test:	As after PEHLA 0511Ra / 12.
Test arrangement:	Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object:	Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra			15		16	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	25.3	24.3	-	-	-
Making current (peak)	L1	kA	-	40.3	47.5	-	-	-
	L2	kA	-	49.7	49.7	-	-	-
	L3	kA	-	48.0	38.5	-	-	-
Breaking current (r.m.s.)	L1	kA	20.4	20.3	19.8	-	-	-
	L2	kA	20.5	20.0	21.1	-	-	-
	L3	kA	19.6	19.8	20.1	-	-	-
	Average value	kA	20.2	20.0	20.4	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.7	14.1	14.0	-	-	-
	L2	kV	14.2	14.7	14.0	-	-	-
	L3	kV	14.0	14.5	14.1	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	μs	-	-	-	-	-	-
	TRV peak value u_c	kV	41.0	40.0	40.0	-	-	-
	Time t_3	μs	-	-	-	-	-	-
	Time delay t_d	μs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/μs	-	-	-	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	62.9	63.0	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	62.9	63.0	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	61.0	61.3	61.6	-	-	-
	Arcing time L1	ms	3.8	7.4	6.6	-	-	-
	L2	ms	8.6	8.4	2.6	-	-	-
	L3	ms	8.8	3.2	6.8	-	-	-
	Break time	ms	69.8	69.7	68.4	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

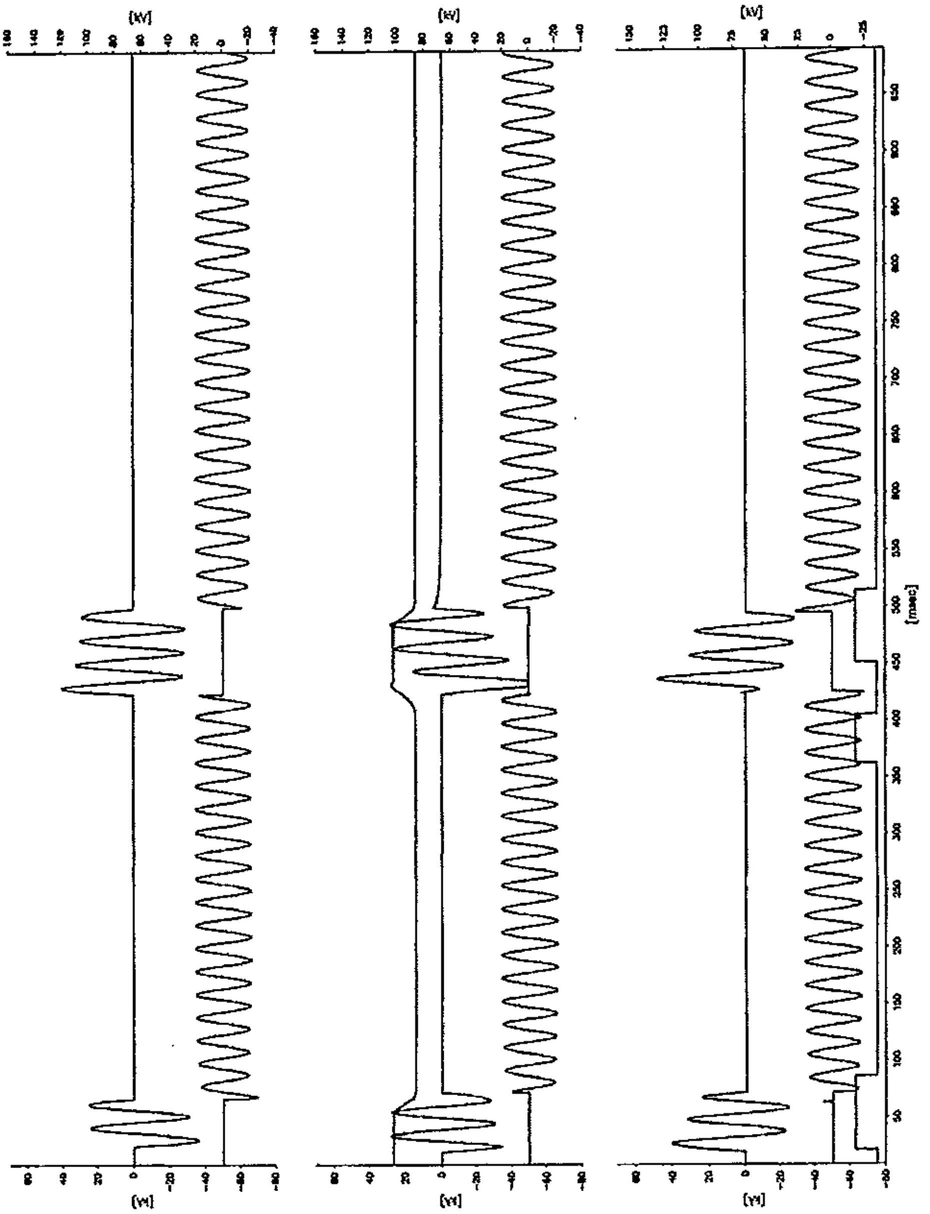
Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks: PEHLA 0511Ra / 13 and 14: Tests with reduced values

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

ВЯРНО С ОРИГИНАЛА

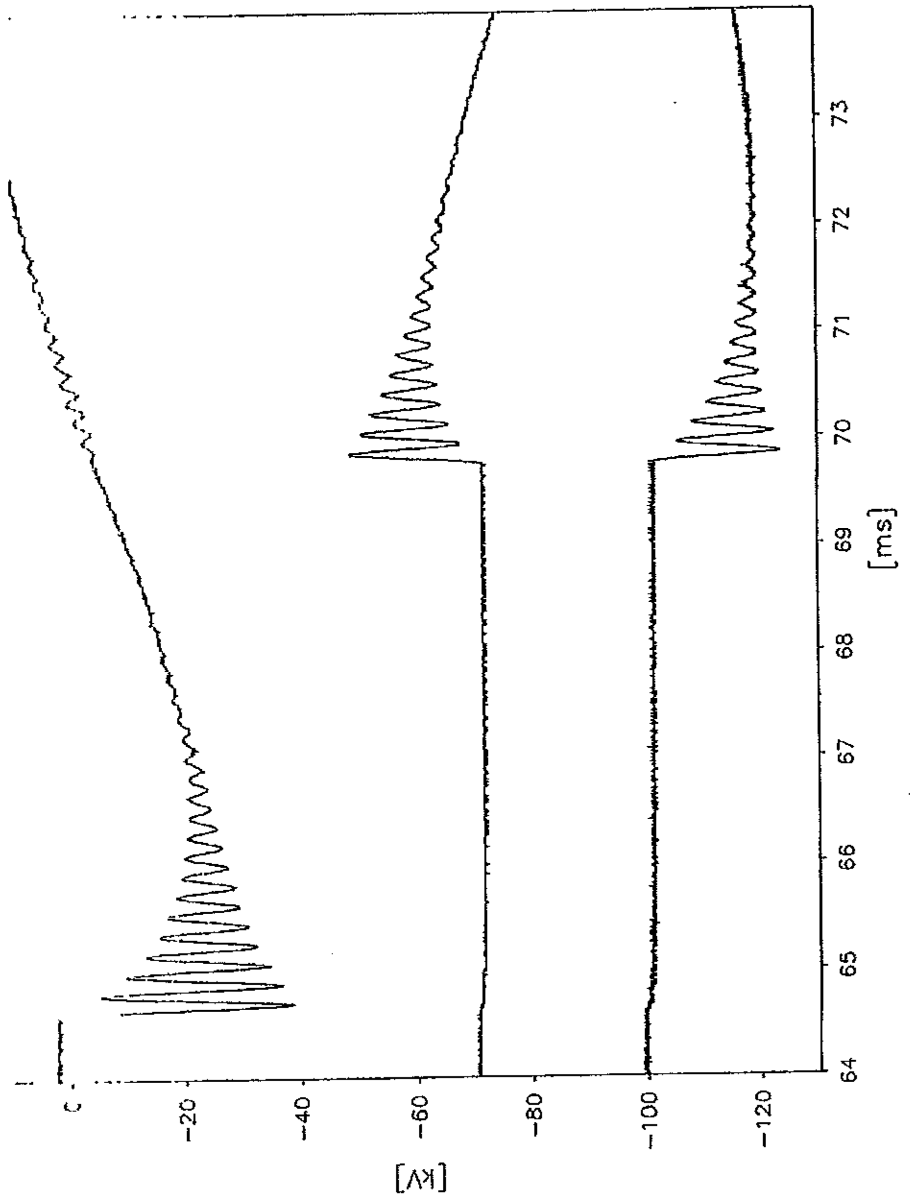
Oscillogram
PEHLA 0511Ra / 15



ВЯРНО С ОРИГИНАЛА

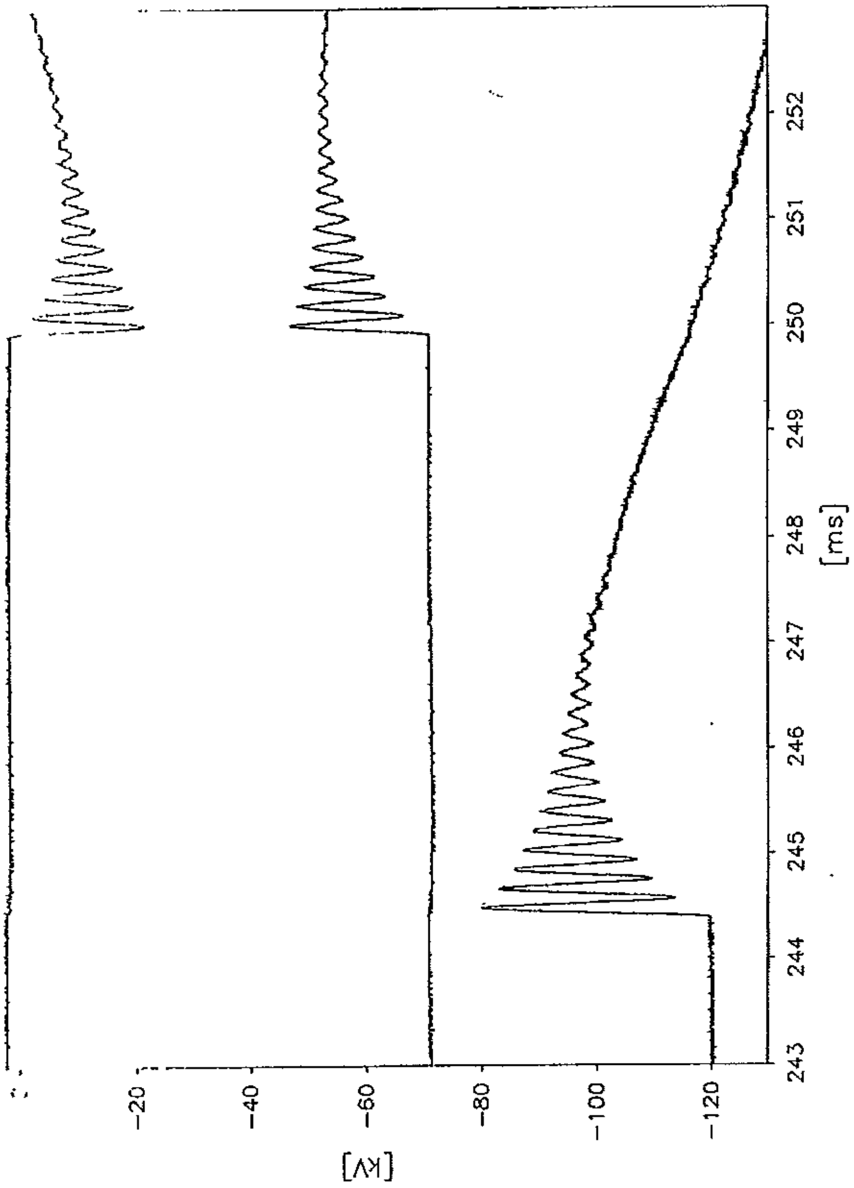
Oscillogram

PEHLA 0511Ra / 15



ВЯРНО С ОРИГИНАЛА

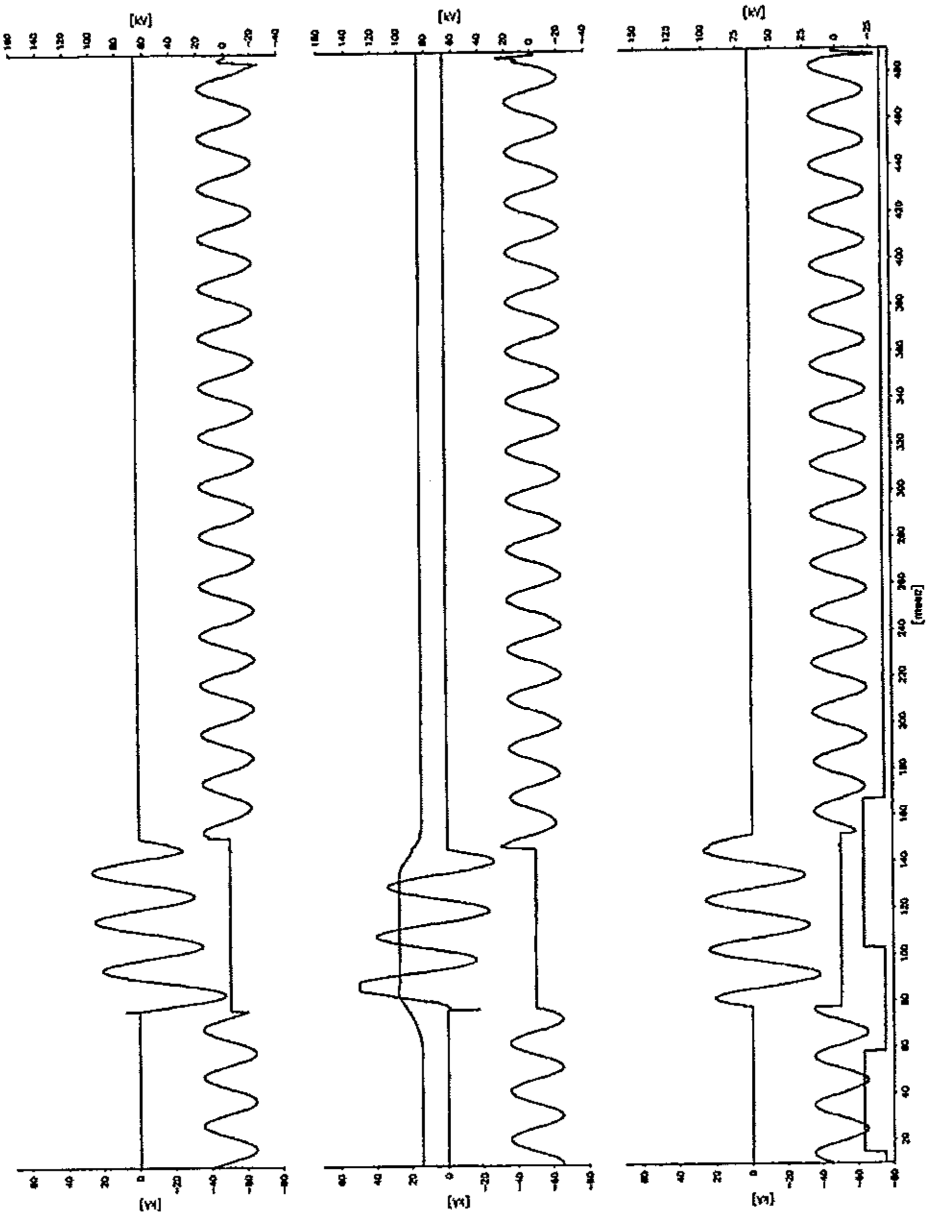
Oscillogram
PEHLA 0511Ra / 15



ВЯРНО С ОРИГИНАЛА

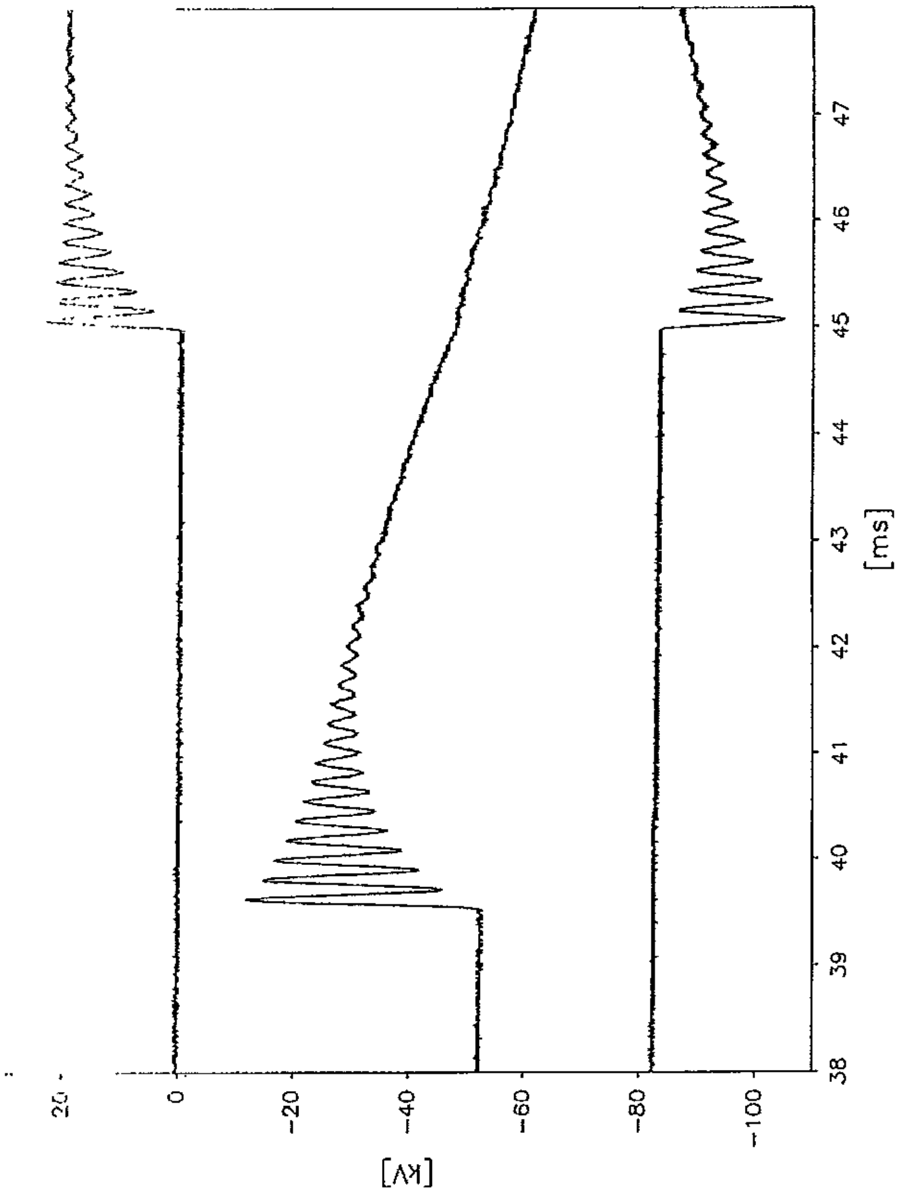
Oscillogram

PEHLA 0511Ra / 16



Oscillogram

PEHLA 0511Ra / 16



ВЯРНО С ОРИГИНАЛА

Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed: Basic short-circuit making and breaking tests (T100a)
Date of test: 09th March 2005
Condition of test object before test: As after PEHLA 0511Ra / 16.
Test arrangement: Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object: Infeed via copper bars to the cable terminals of the switchgear, short-circuited via copper bars at the busbar connection, short-circuit point earthed via cable.

Test No. PEHLA 0511Ra			19	20	21	-	-	-
Operating sequence and time intervals			O-3min-O-3min-O			-	-	-
Applied voltage		kV	-	-	-	-	-	-
Breaking current (r.m.s.)	L1	kA	18.7	18.6	17.9	-	-	-
	L2	kA	18.2	19.0	18.7	-	-	-
	L3	kA	18.7	18.0	18.8	-	-	-
	Average value	kA	18.5	18.5	18.5	-	-	-
Breaking current - last current loop (peak)	L1	kA	-	-	-	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Duration of the last current loop	L1	ms	-	-	-	-	-	-
	L2	ms	-	-	-	-	-	-
	L3	ms	-	-	-	-	-	-
DC-component	L1	%	< 20	< 20	< 20	-	-	-
	L2	%	< 20	< 20	< 20	-	-	-
	L3	%	< 20	< 20	< 20	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.6	13.4	13.7	-	-	-
	L2	kV	13.9	13.5	13.9	-	-	-
	L3	kV	13.7	13.8	13.8	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	39.9	38.9	38.4	-	-	-
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
O-Operation	Voltage of opening device	V	121	121	121	-	-	-
	Opening time	ms	46.6	46.9	47.7	-	-	-
	Arcing time L1	ms	5.2	8.4	8.6	-	-	-
	L2	ms	5.2	3.6	8.6	-	-	-
	L3	ms	0.8	8.4	3.8	-	-	-
	Break time	ms	51.8	55.3	56.3	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

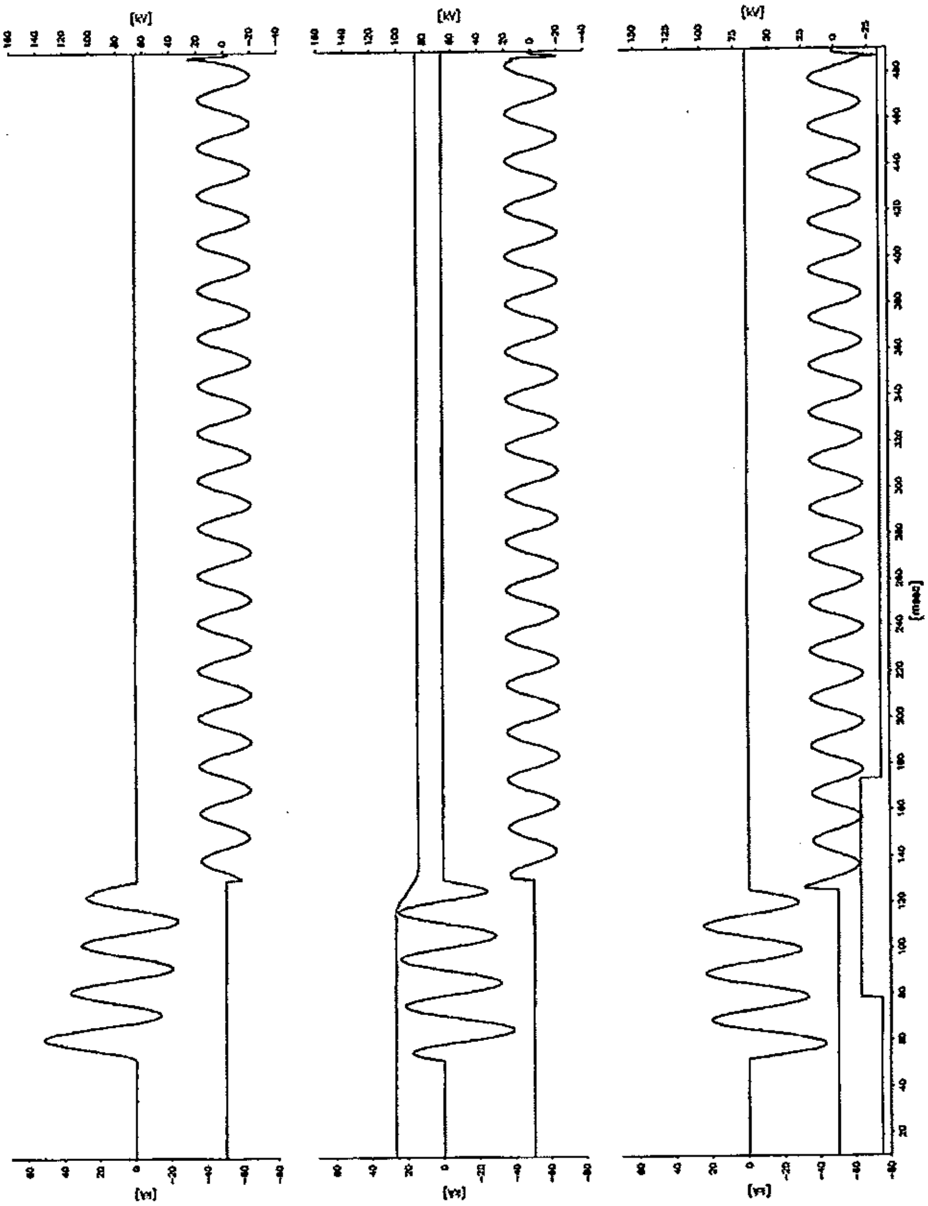
Remarks:
Before PEHLA 0511Ra / 17: Infeed direction inverted
PEHLA 0511Ra / 17 and 18: Test with reduced values
PEHLA 0511Ra / 19 to 21: Tests for determination of DC-component

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

ВЯРНО С ОРИГИНАЛА

Oscillogram

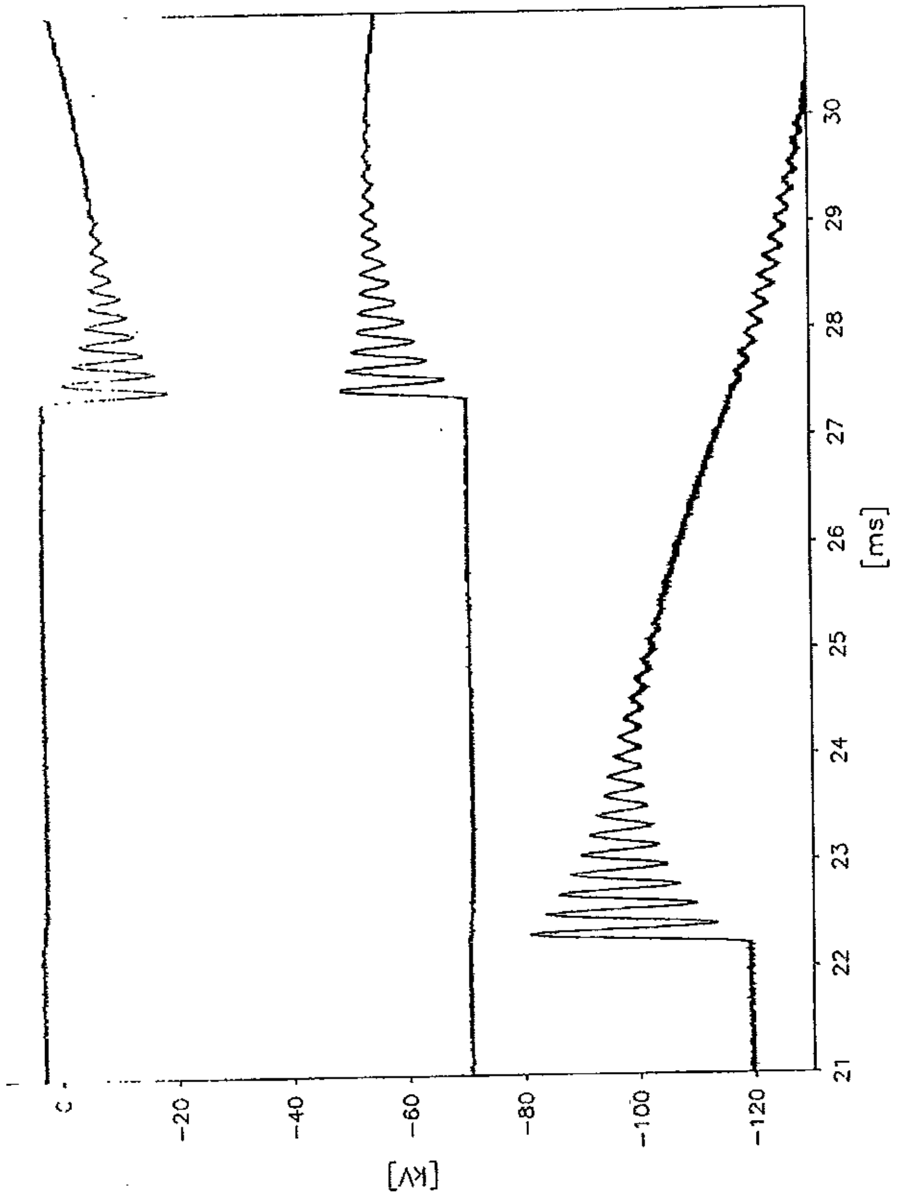
PEHLA 0511Ra / 19



ВЯРНО С ОРИГИНАЛА

Oscillogram

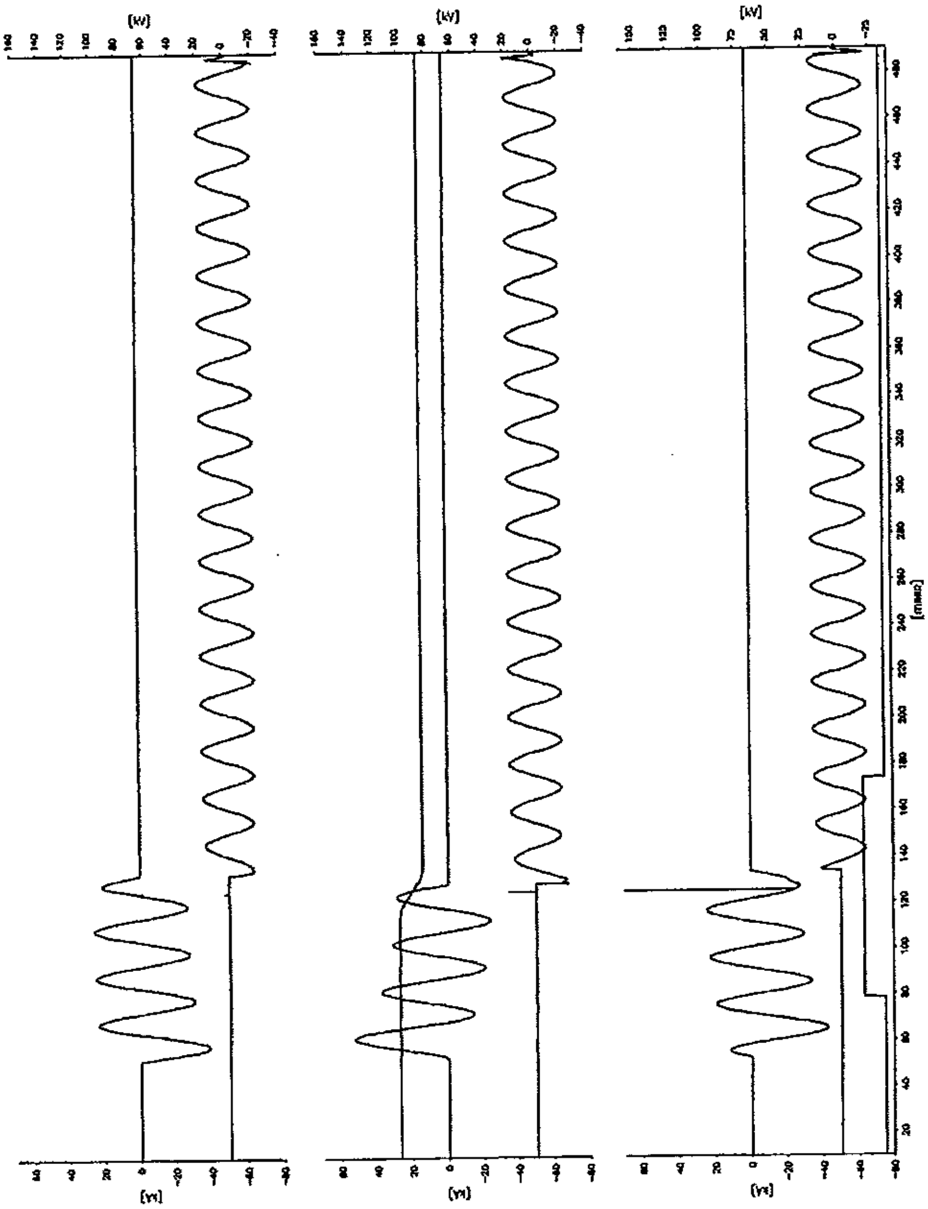
PEHLA 0511Ra / 19



ВЯРНО С ОРИГИНАЛА

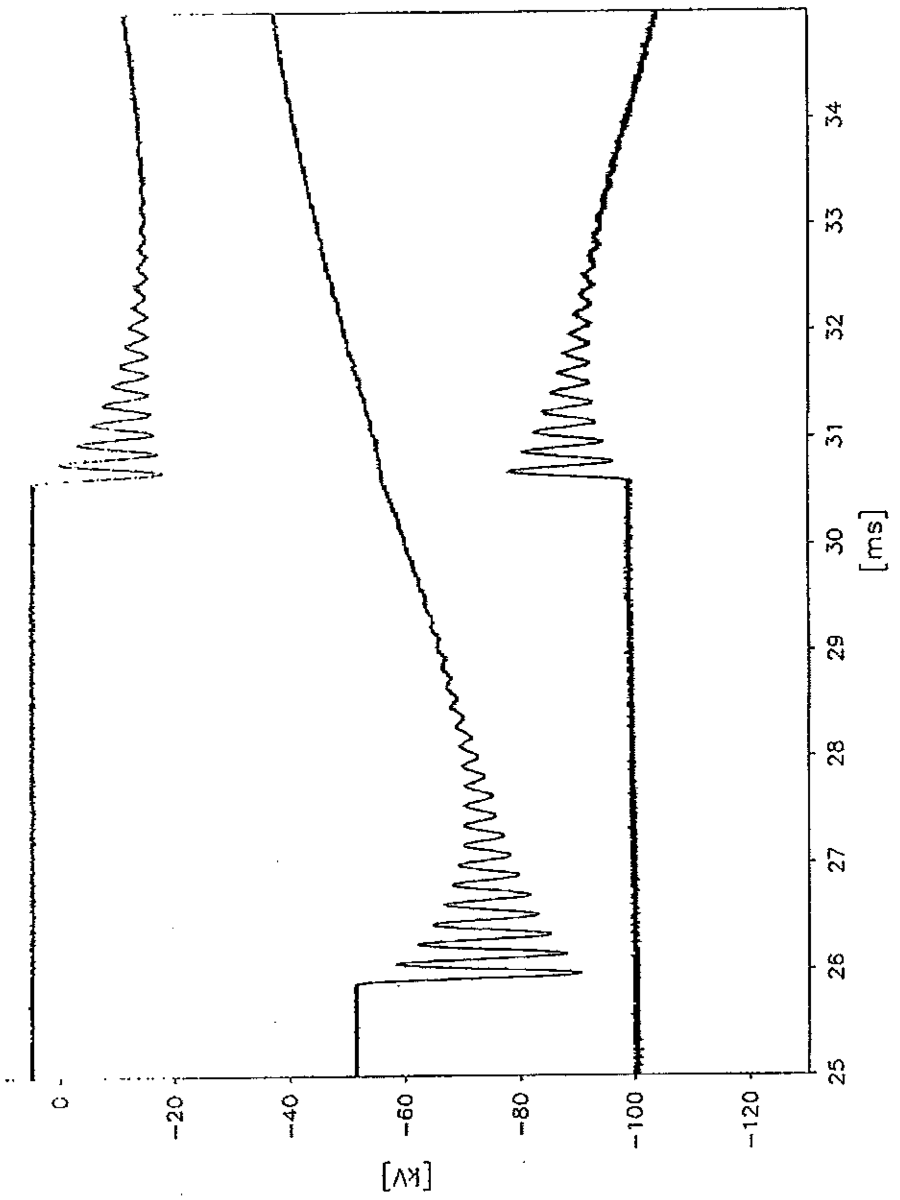
Oscillogram

PEHLA 0511Ra / 20



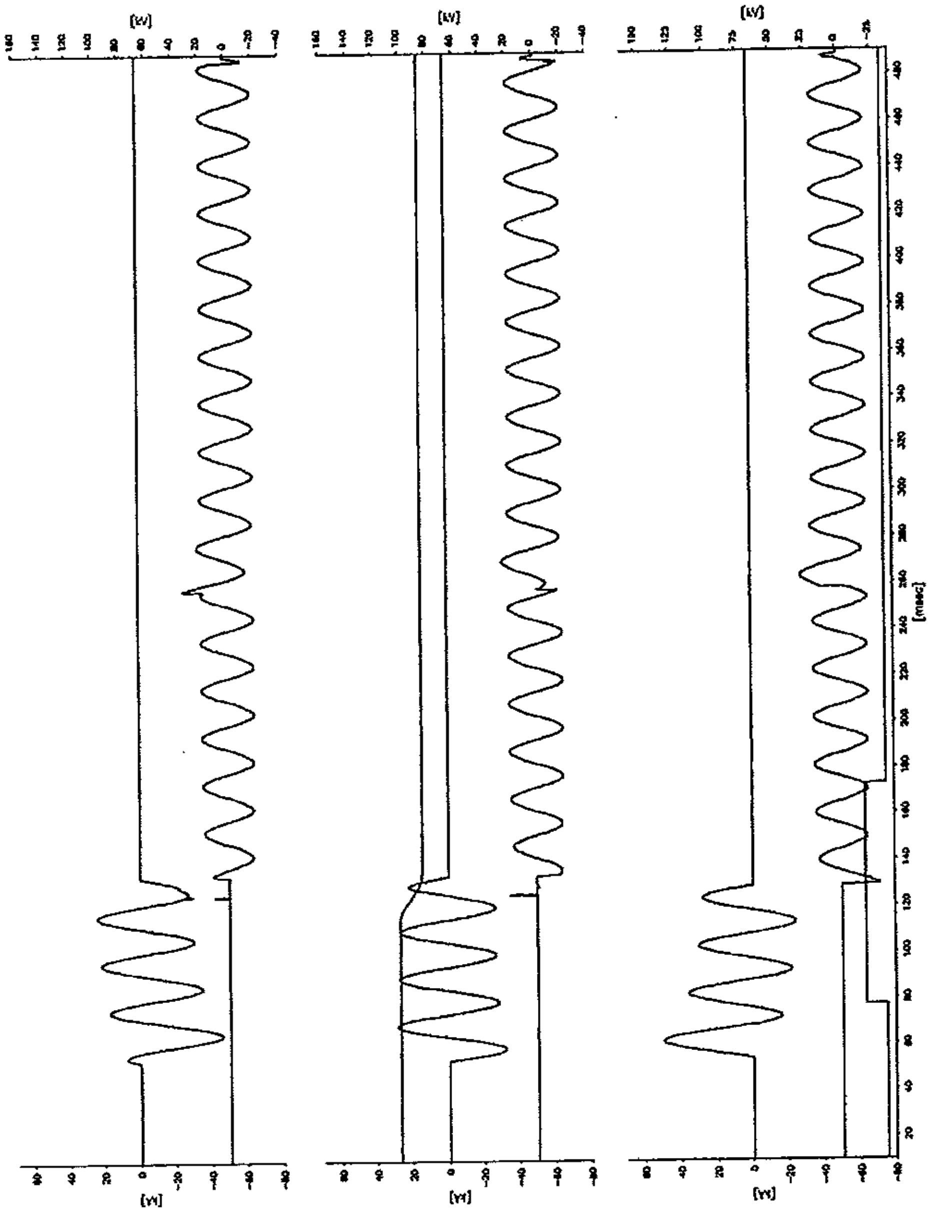
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 20



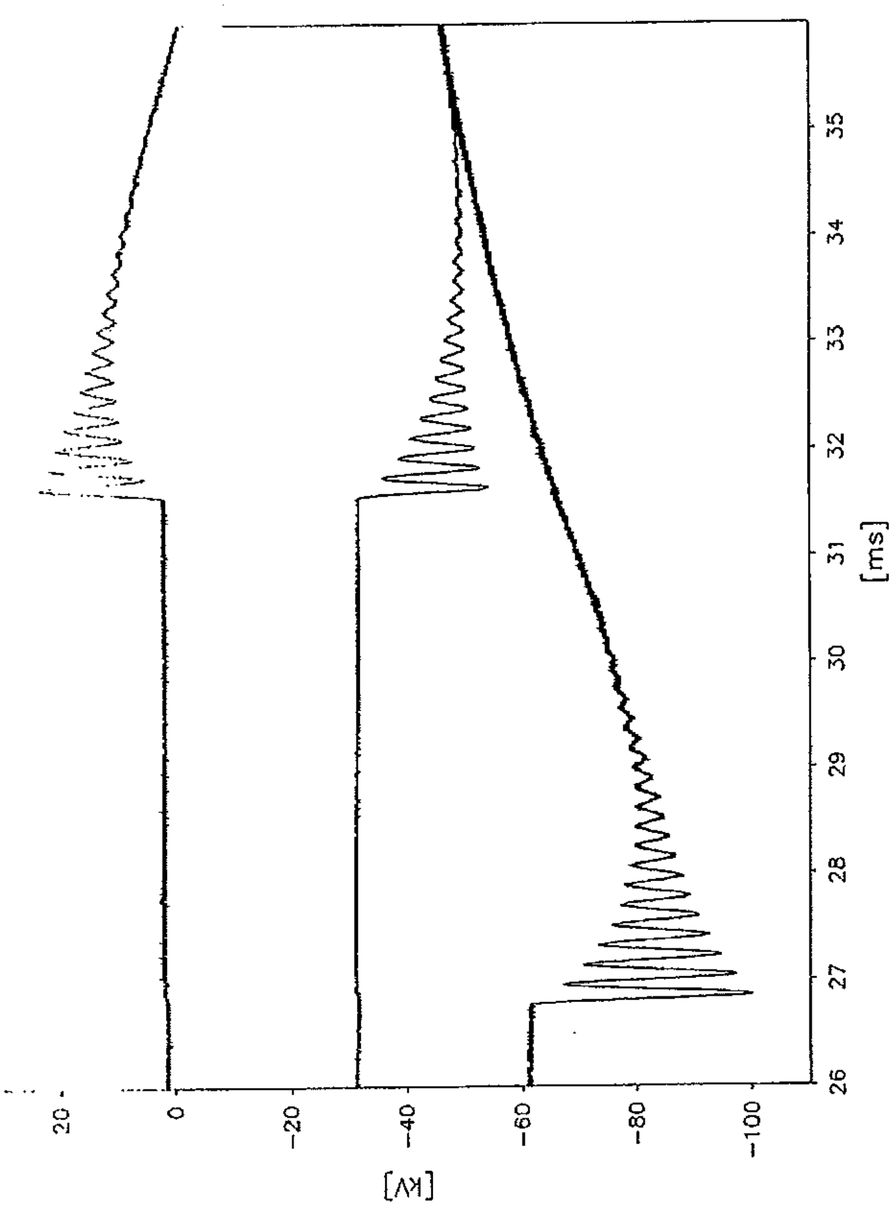
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 21



ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 21



ВЯРНО С ОРИГИНАЛА

Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed:	Basic short-circuit making and breaking tests (T100a)
Date of test:	09th March 2005
Condition of test object before test:	As after PEHLA 0511Ra / 21.
Test arrangement:	Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object:	Infeed via copper bars to the cable terminals of the switchgear, short-circuited via copper bars at the busbar connection, short-circuit point earthed via cable.

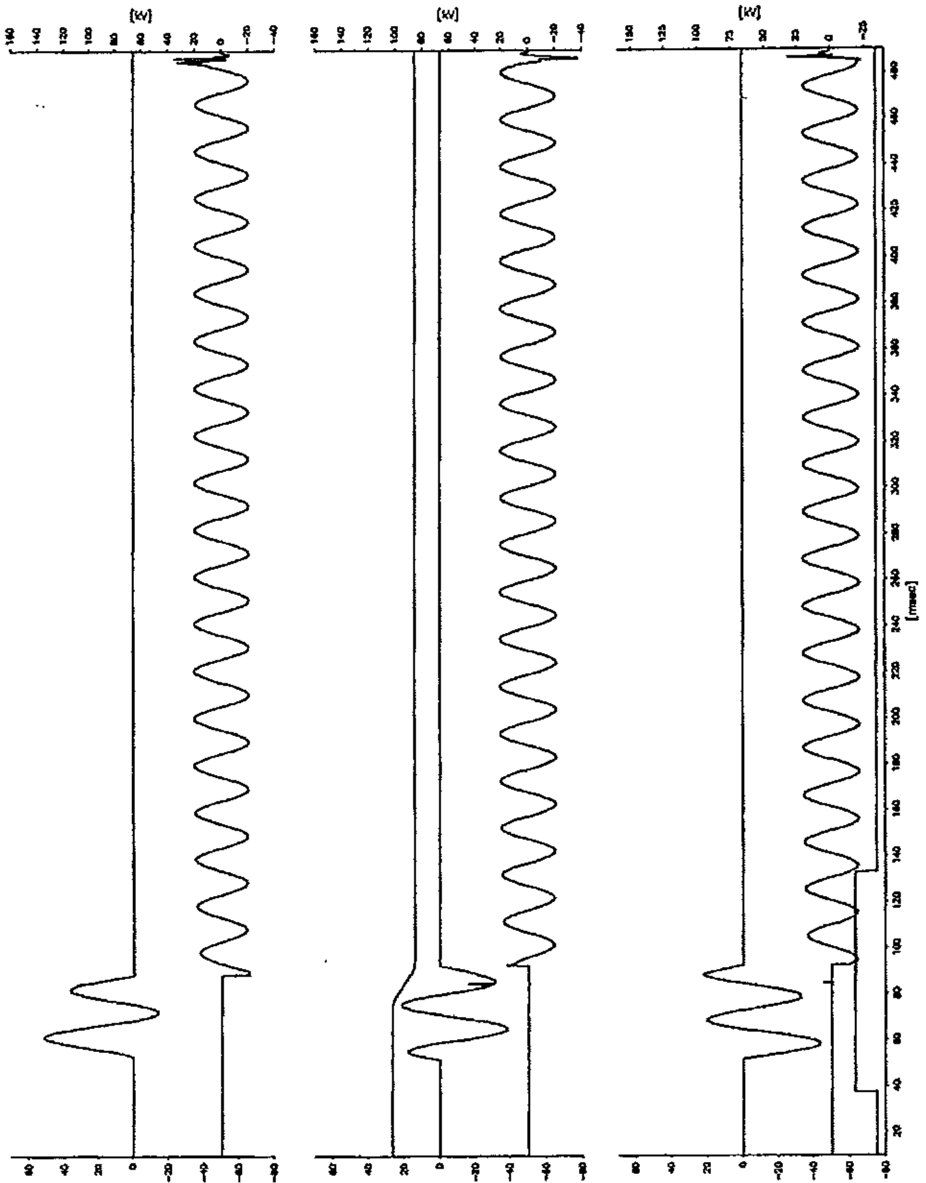
Test No. PEHLA 0511Ra			23	24	25	26	27	28
Operating sequence and time intervals			O-3min-O-3min-O-3min-O-3min-O-3min-O-					
Applied voltage		kV	-	-	-	-	-	-
Breaking current (r.m.s.)	L1	kA	20.7	20.5	20.6	20.6	20.5	20.5
	L2	kA	20.1	19.8	19.9	20.9	20.5	20.6
	L3	kA	20.7	20.1	20.0	20.5	19.7	19.8
	Average value	kA	20.5	20.1	20.2	20.7	20.2	20.3
Breaking current - last current loop (peak)	L1	kA	36.9	-	-	-	-	-
	L2	kA	-	37.3	37.3	37.3	-	-
	L3	kA	-	-	-	-	36.0	36.0
Duration of the last current loop	L1	ms	12.8	-	-	-	-	-
	L2	ms	-	12.6	12.6	12.6	-	-
	L3	ms	-	-	-	-	12.2	12.2
DC-component	L1	%	32.2	< 20	< 20	< 20	35.7	35.7
	L2	%	< 20	37.8	39.9	37.8	< 20	< 20
	L3	%	< 20	28.3	29.7	28.0	33.7	34.0
Recovery voltage (r.m.s)	L1	kV	13.9	13.7	13.7	13.7	13.7	13.8
	L2	kV	13.9	13.6	14.1	13.7	14.1	14.0
	L3	kV	14.2	13.5	14.1	14.1	14.0	14.1
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	
	Time t_1	µs	-	-	-	-	-	
	TRV peak value u_c	kV	40.8	39.6	37.4	41.4	37.4	37.4
	Time t_3	µs	-	-	-	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	-	-	-	-	-	-
O-Operation	Voltage of opening device	V	121	121	121	121	121	121
	Opening time	ms	47.0	47.3	45.8	44.6	47.0	46.0
	Arcing time L1	ms	3.8	6.6	6.4	6.0	0.8	0.8
	L2	ms	7.8	6.4	8.0	10.2	6.6	6.6
	L3	ms	8.0	0.8	1.8	10.4	6.4	6.6
	Break time	ms	55.0	53.7	53.8	55.0	53.6	52.6
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	no	no	no
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	P	P	P

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

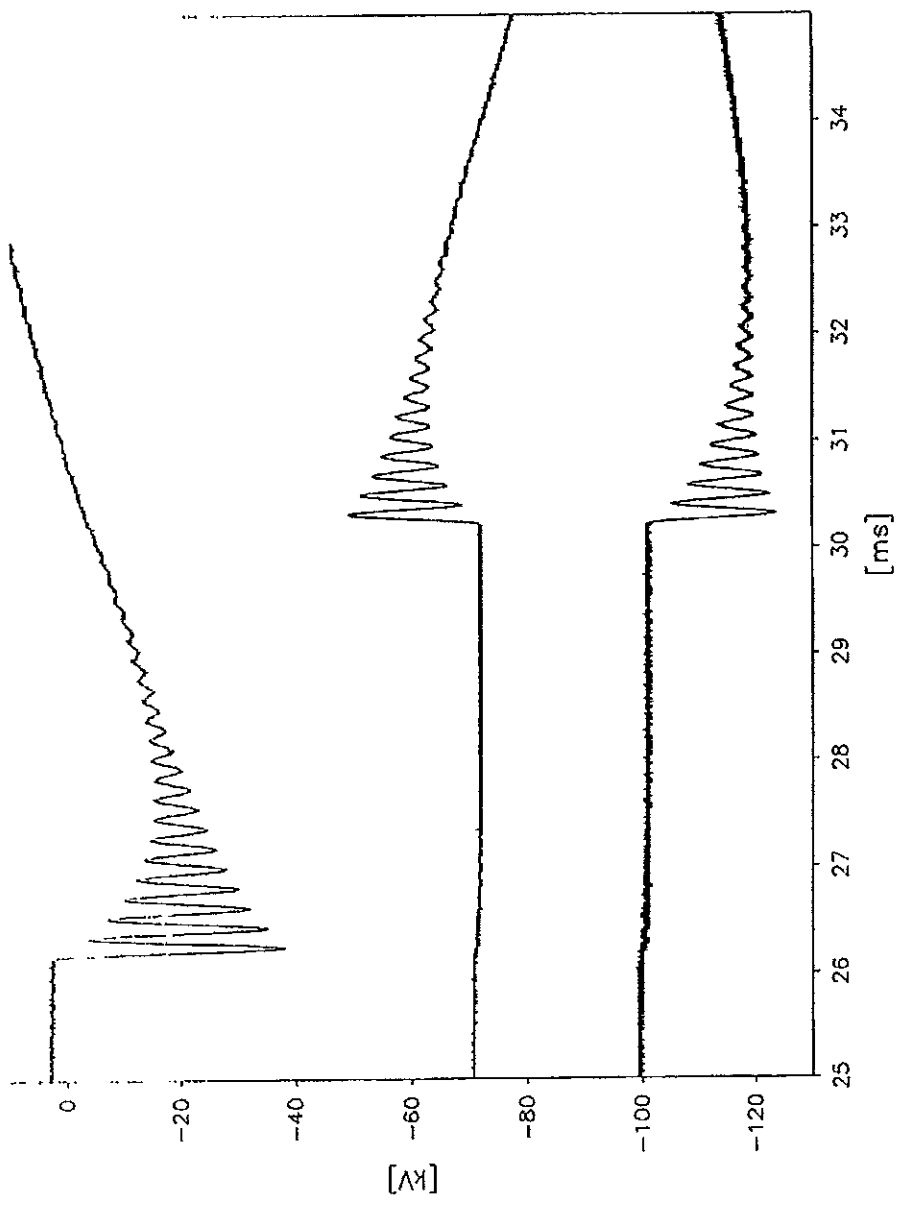
Remarks: PEHLA 0511Ra / 22: Test with reduced values.

Condition of test object after test: Switchgear and circuit-breaker were not inspected.

Oscillogram
PEHLA 0511Ra / 23



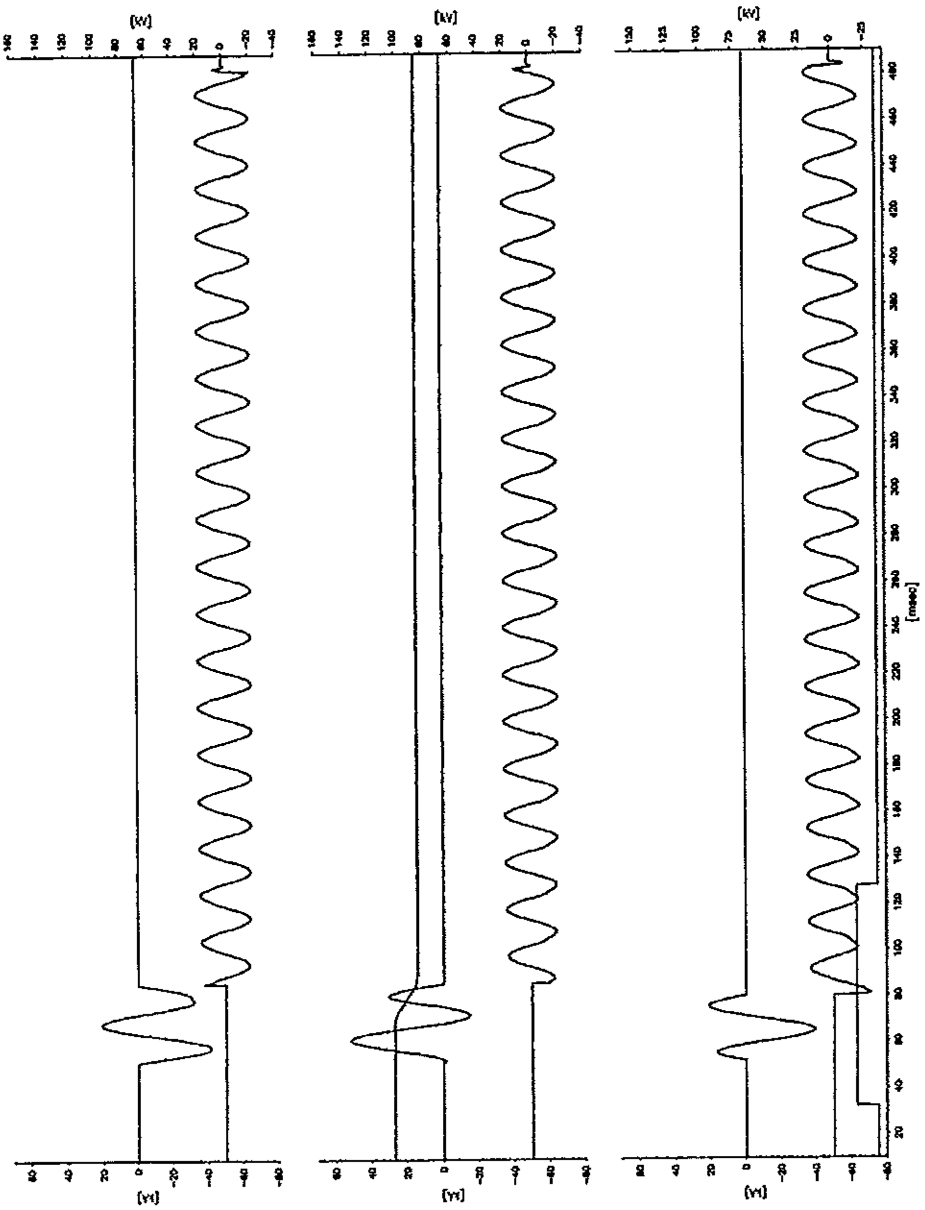
Oscillogram
PEHLA 0511Ra / 23



ВЯРНО С ОРИГИН

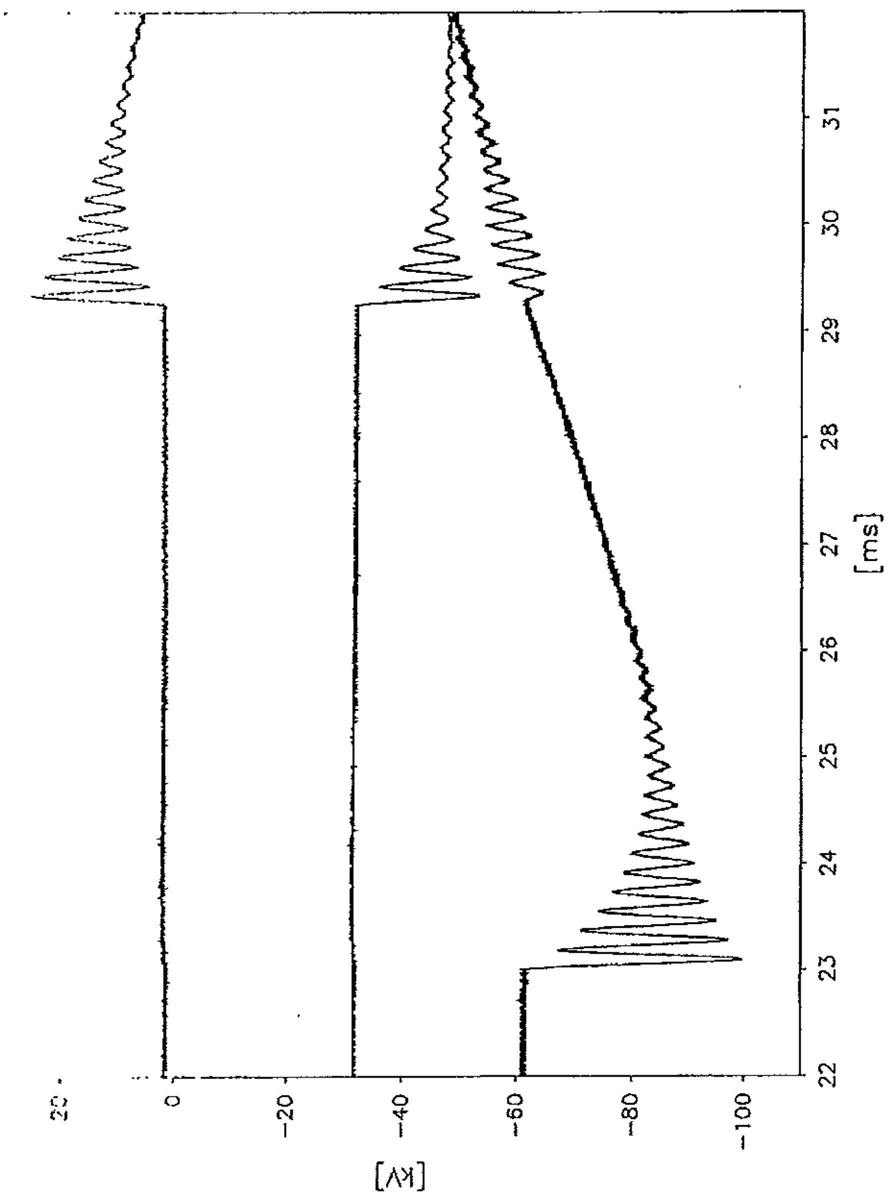
Oscillogram

PEHLA 0511Ra / 24



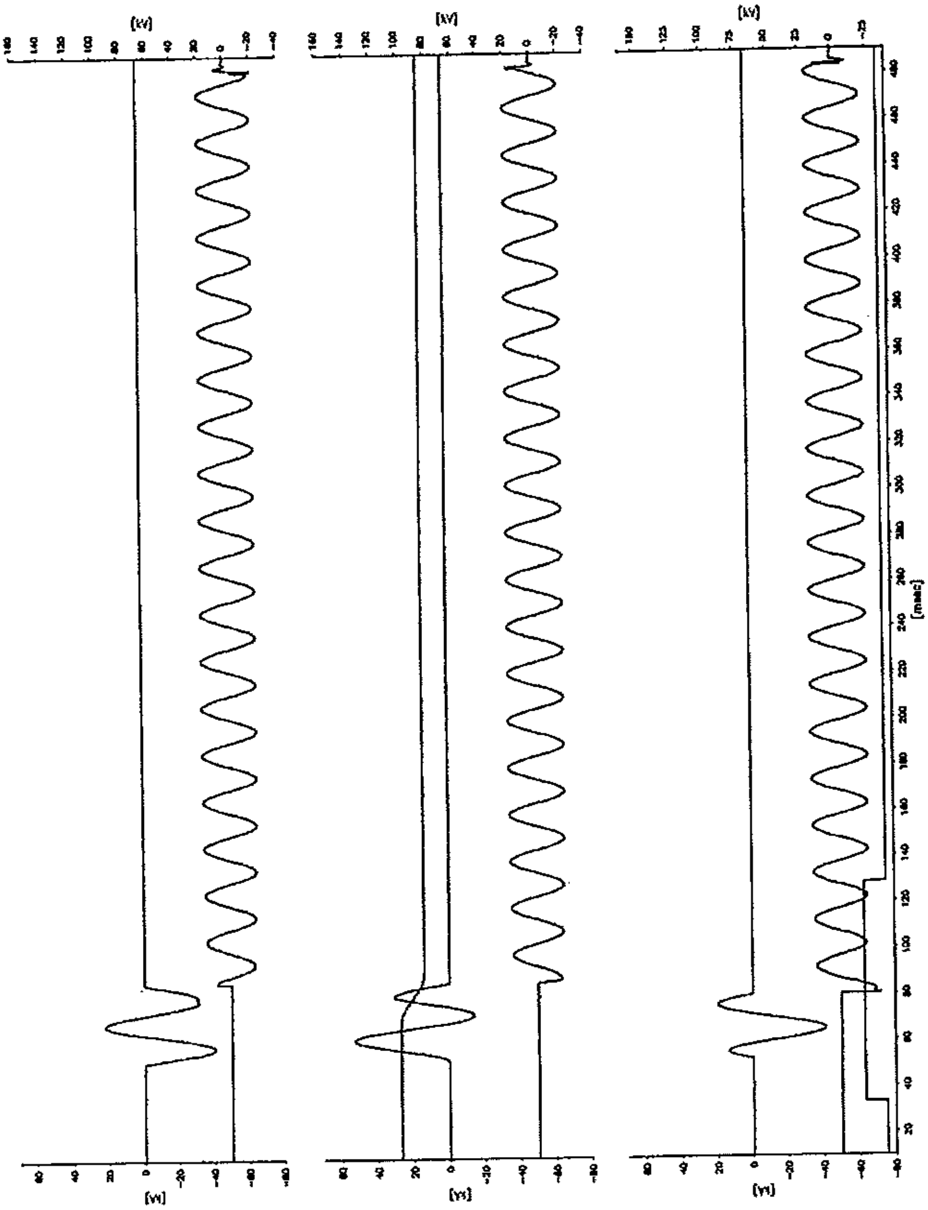
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 24



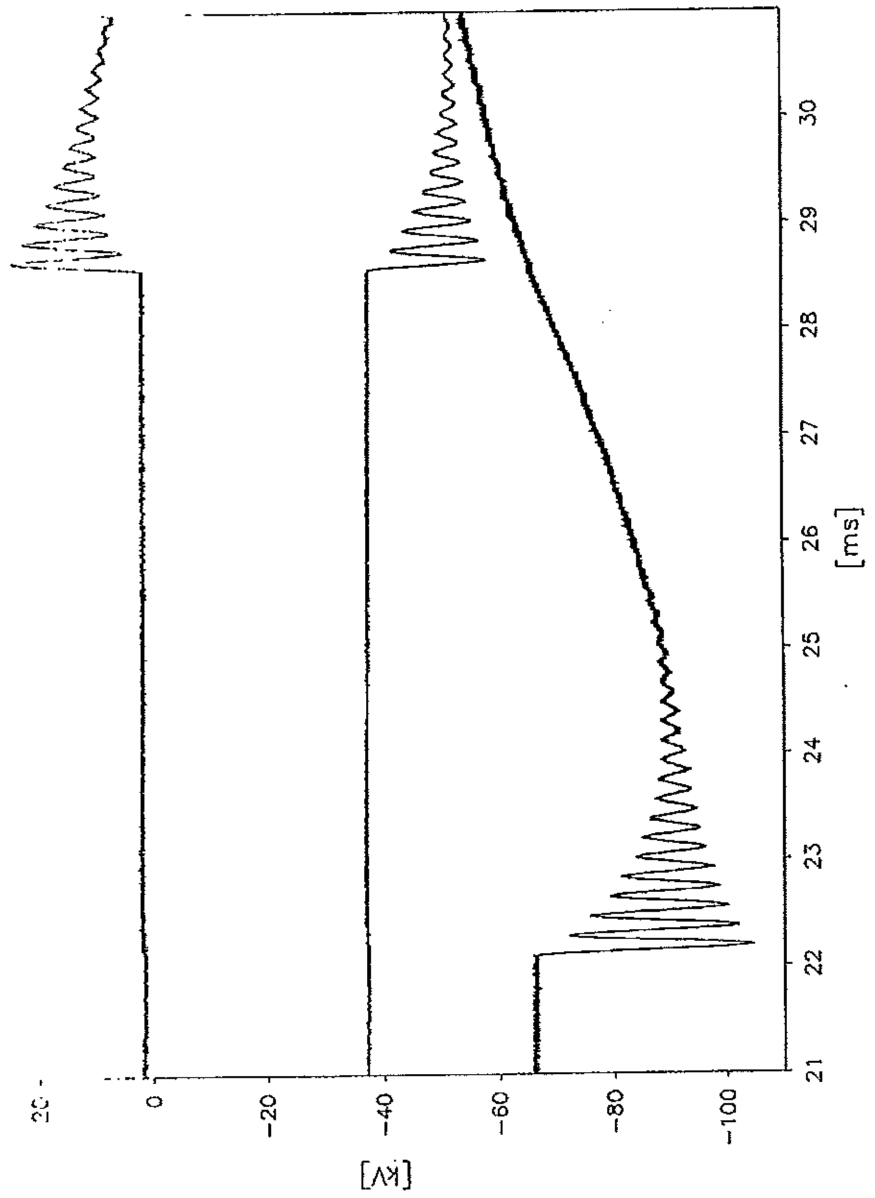
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 25

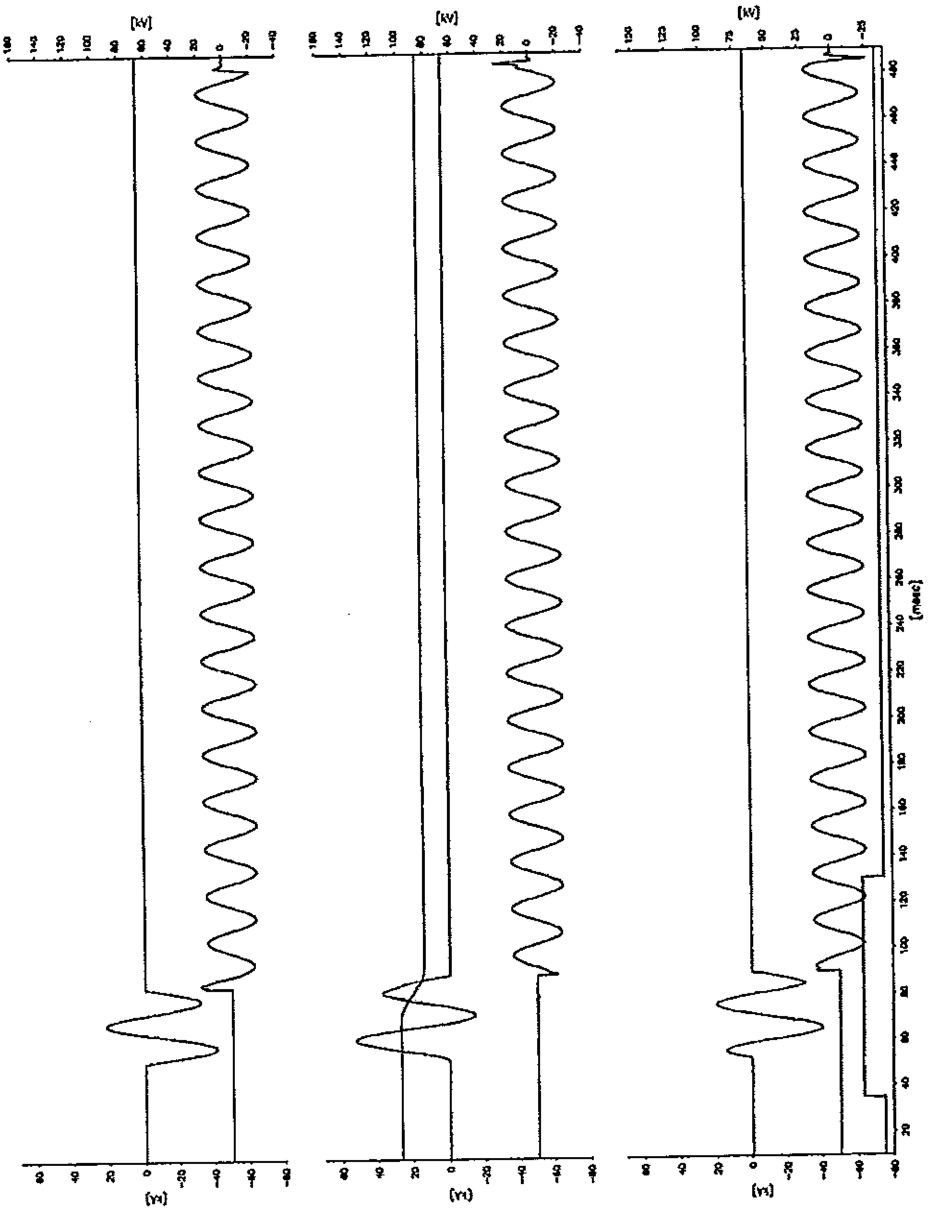


ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 25

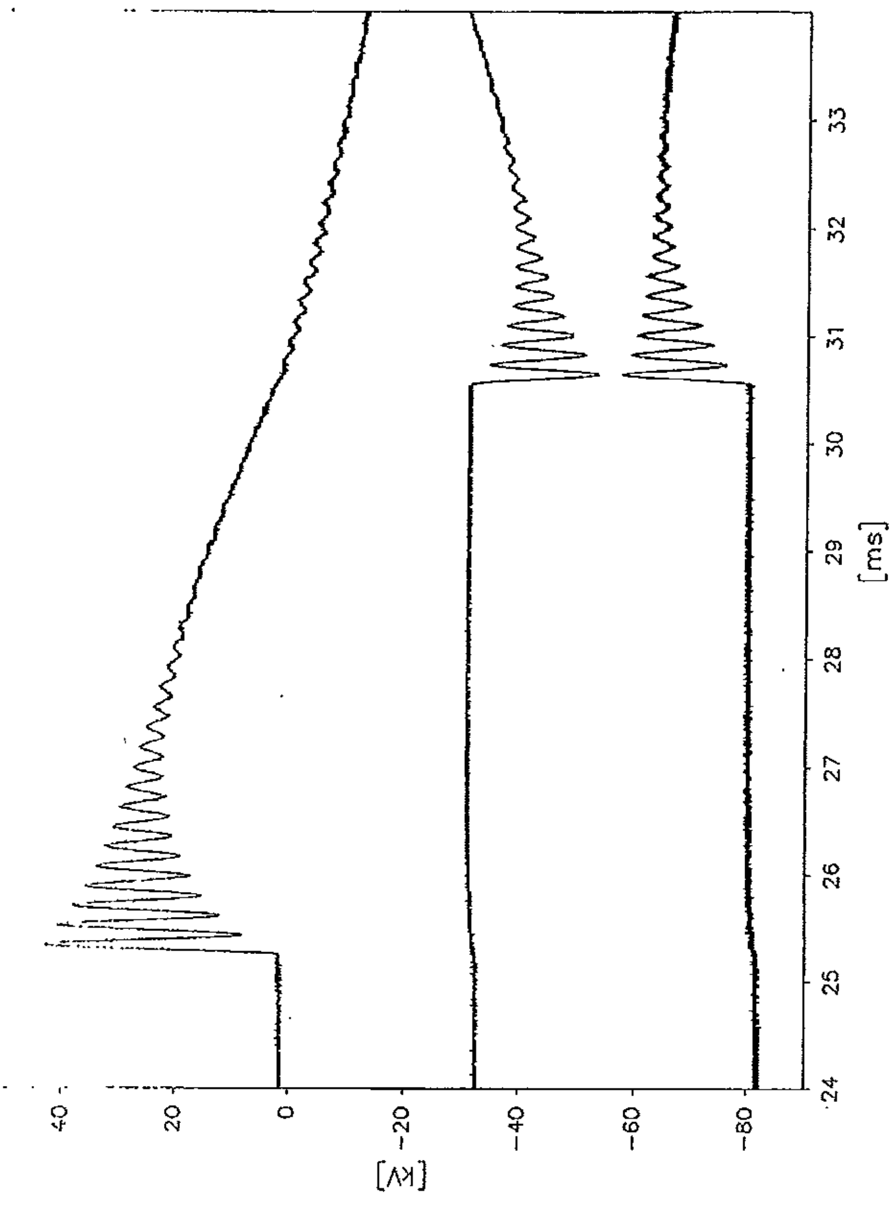


Oscillogram
PEHLA 0511Ra / 26



ВЯРНО С ОРИГИНАЛА

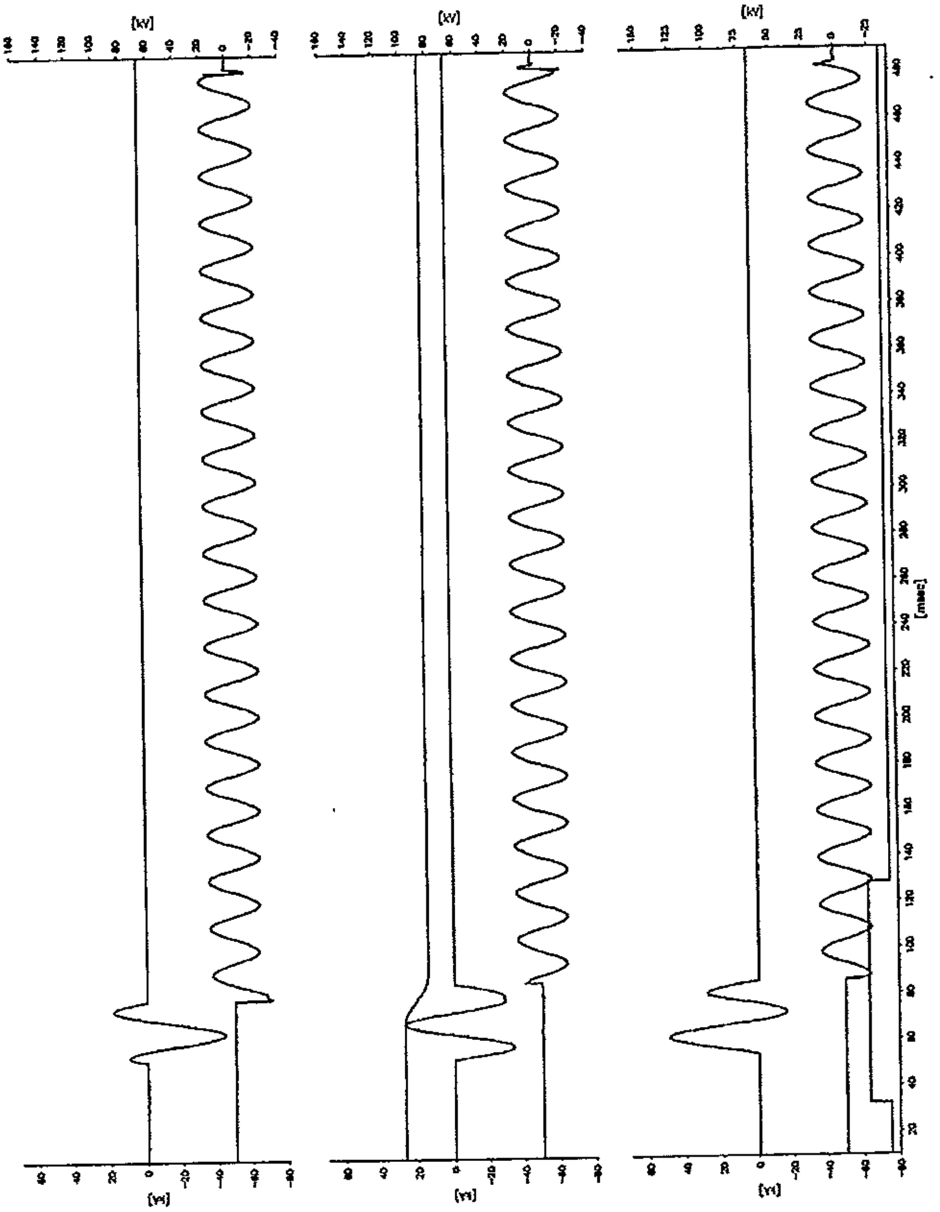
Oscillogram
PEHLA 0511Ra / 26



ВЯРНО С ОРИГИНАЛА

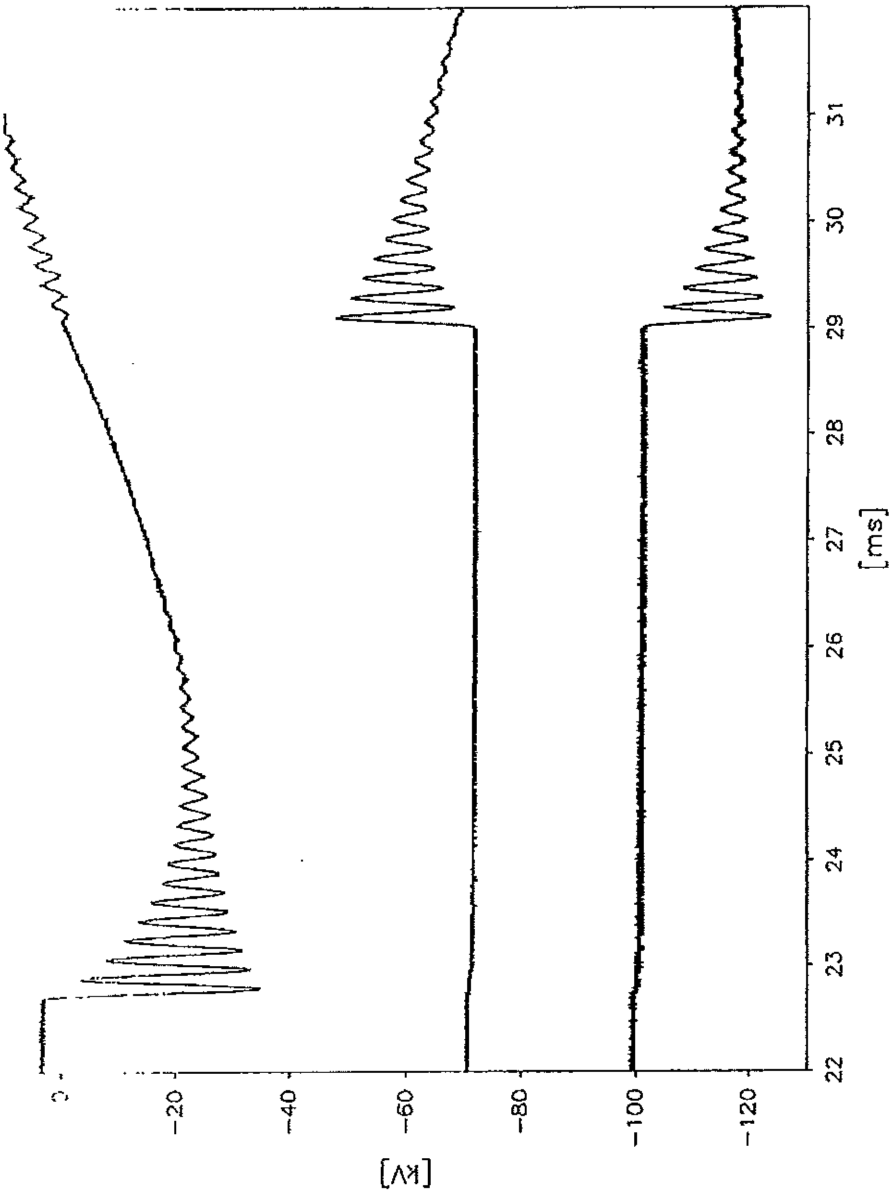
Oscillogram

PEHLA 0511Ra / 27



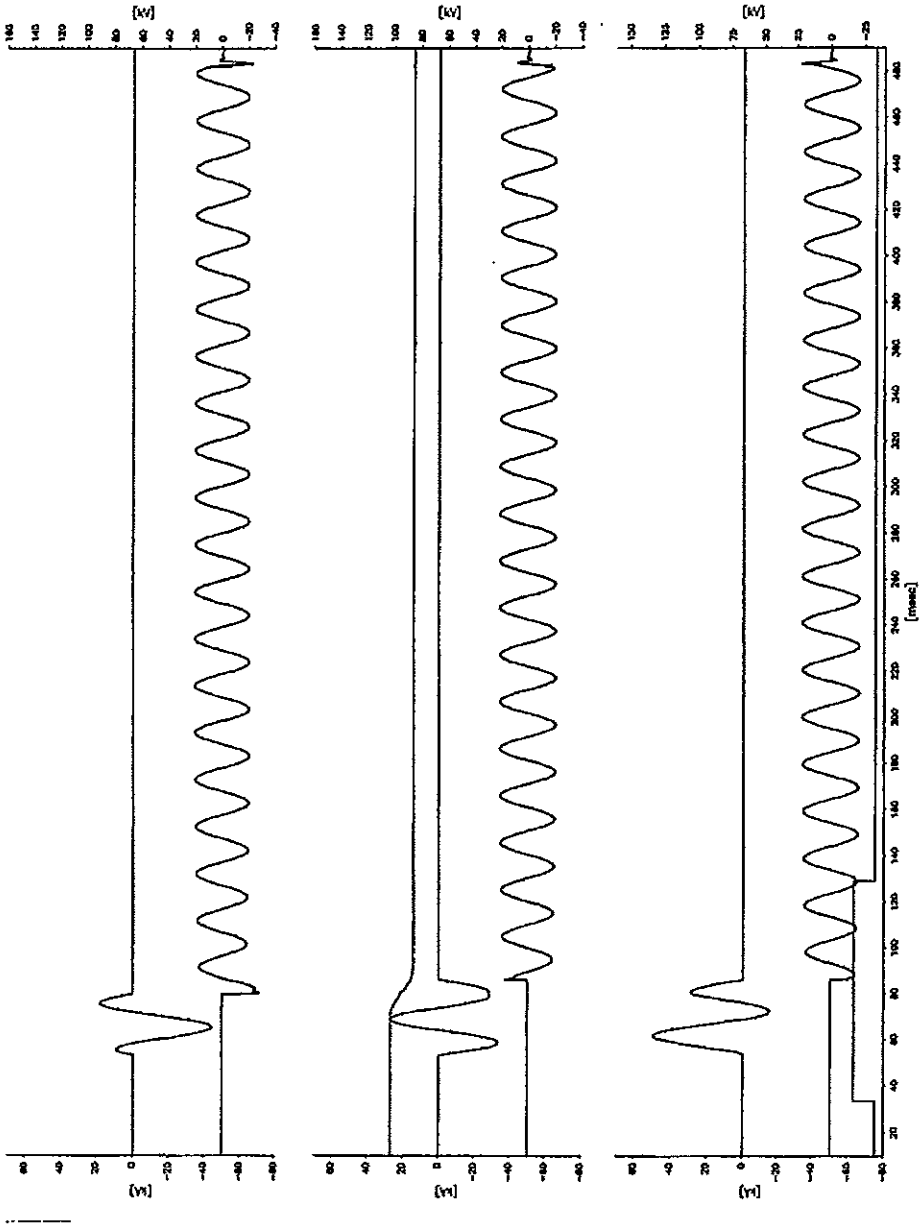
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 27



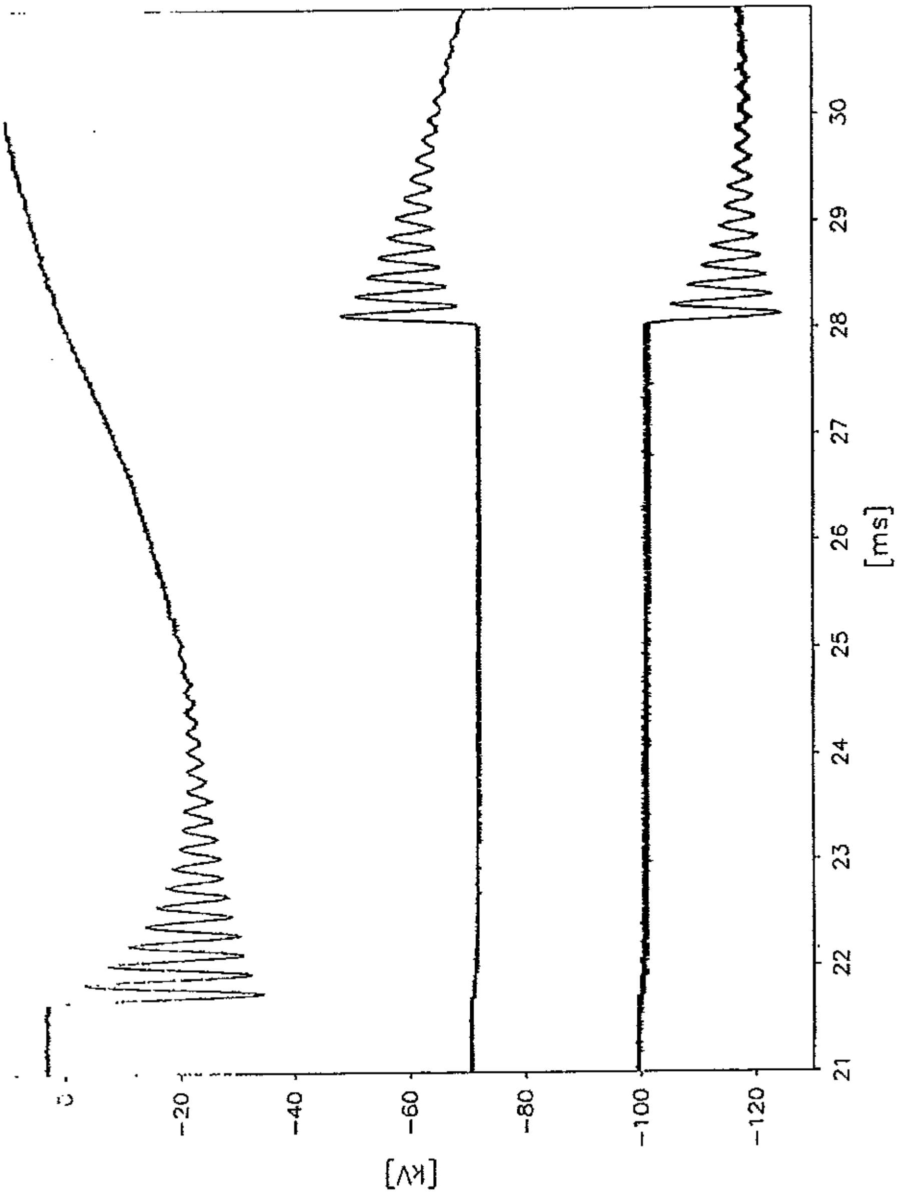
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 28



ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 28



ВЯРНО С ОРИГИНАЛА

Test Results

Basic Short-Circuit Making and Breaking Tests

Test performed:	Basic short-circuit making and breaking tests (T10)
Date of test:	10th March 2005
Condition of test object before test:	As after PEHLA 0511Ra / 28.
Test arrangement:	Direct test circuit, circuit-breaker in gas insulated switchgear
Connections to test object:	Infeed via copper bars to the busbar connection of the switchgear, short-circuited via copper bar at the cable terminals, short-circuit point earthed via cable.

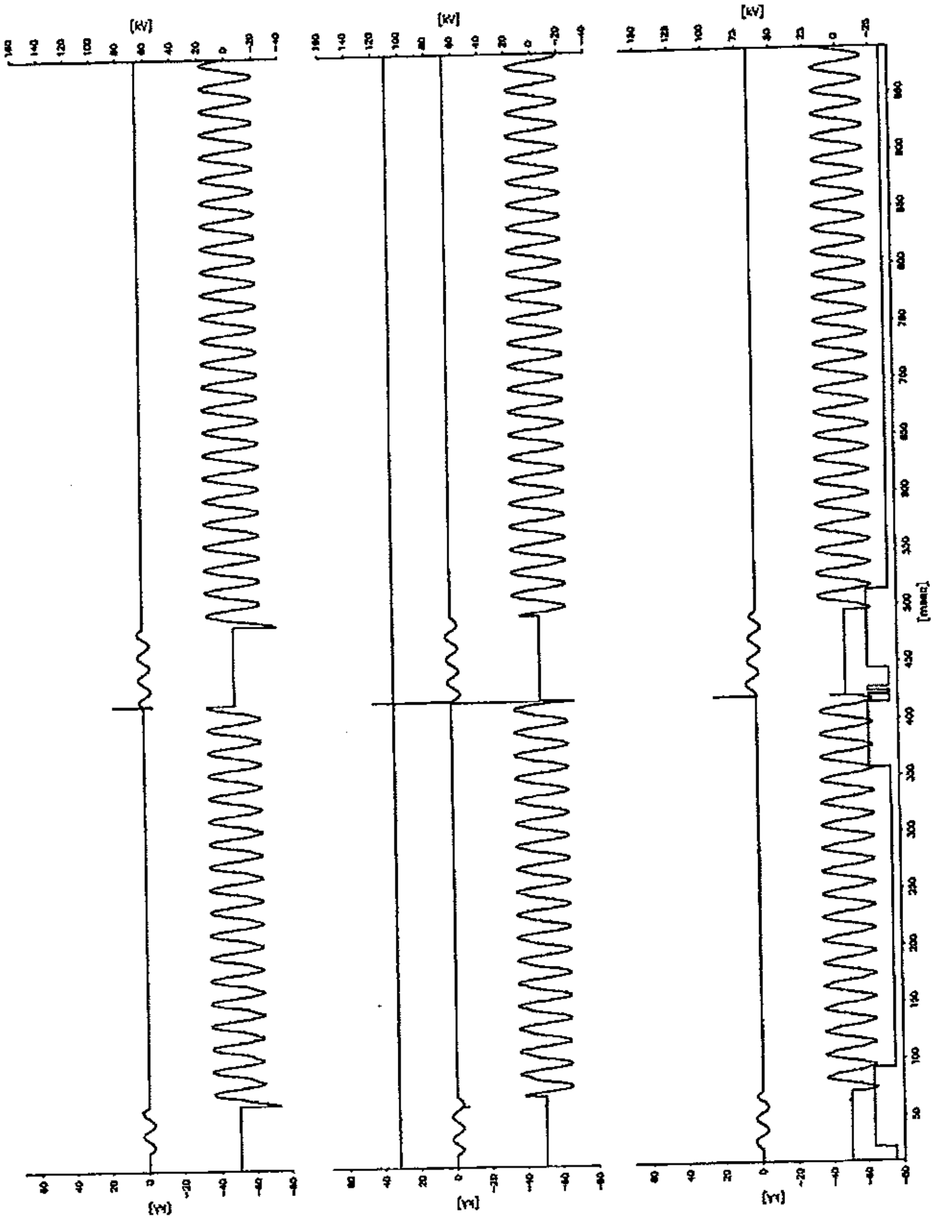
Test No. PEHLA 0511Ra			29		30	-	-	-
Operating sequence and time intervals			O-0.3s-CO-15s-CO			-	-	-
Applied voltage		kV	-	24.5	24.2	-	-	-
Making current (peak)	L1	kA	-	4.02	3.6	-	-	-
	L2	kA	-	4.85	5.2	-	-	-
	L3	kA	-	5.48	5.3	-	-	-
Breaking current (r.m.s.)	L1	kA	2.21	2.31	2.30	-	-	-
	L2	kA	2.28	2.34	2.28	-	-	-
	L3	kA	2.24	2.31	2.25	-	-	-
	Average value	kA	2.24	2.32	2.28	-	-	-
Recovery voltage (r.m.s)	L1	kV	13.8	14.5	14.3	-	-	-
	L2	kV	14.0	14.6	14.2	-	-	-
	L3	kV	13.7	14.6	14.5	-	-	-
Transient recovery voltage	Voltage u_1	kV	-	-	-	-	-	-
	Time t_1	µs	-	-	-	-	-	-
	TRV peak value u_c	kV	46.5	48.5	44.0	-	-	-
	Time t_3	µs	65.0	65.0	65.0	-	-	-
	Time delay t_d	µs	-	-	-	-	-	-
	Rate of rise u_c/t_3	kV/µs	0.715	0.746	0.677	-	-	-
C-Operation	Voltage of closing device	V	-	94	94	-	-	-
	Closing time	ms	-	63.4	64.4	-	-	-
	Pre-arcing time	ms	-	-	-	-	-	-
	Make time	ms	-	63.4	64.4	-	-	-
O-Operation	Voltage of opening device	V	77	77	77	-	-	-
	Opening time	ms	61.3	63.1	60.4	-	-	-
	Arcing time L1	ms	3.8	2.2	9.4	-	-	-
	L2	ms	9.0	7.0	9.4	-	-	-
	L3	ms	9.0	7.0	4.0	-	-	-
	Break time	ms	70.3	70.1	69.8	-	-	-
Emission of flame/gas/oil, occurrence of NSDD			no	no	no	-	-	-
Number of valid test			-	-	-	-	-	-
Test result			P	P	P	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks: PEHLA 0511Ra / 31: No-load operation

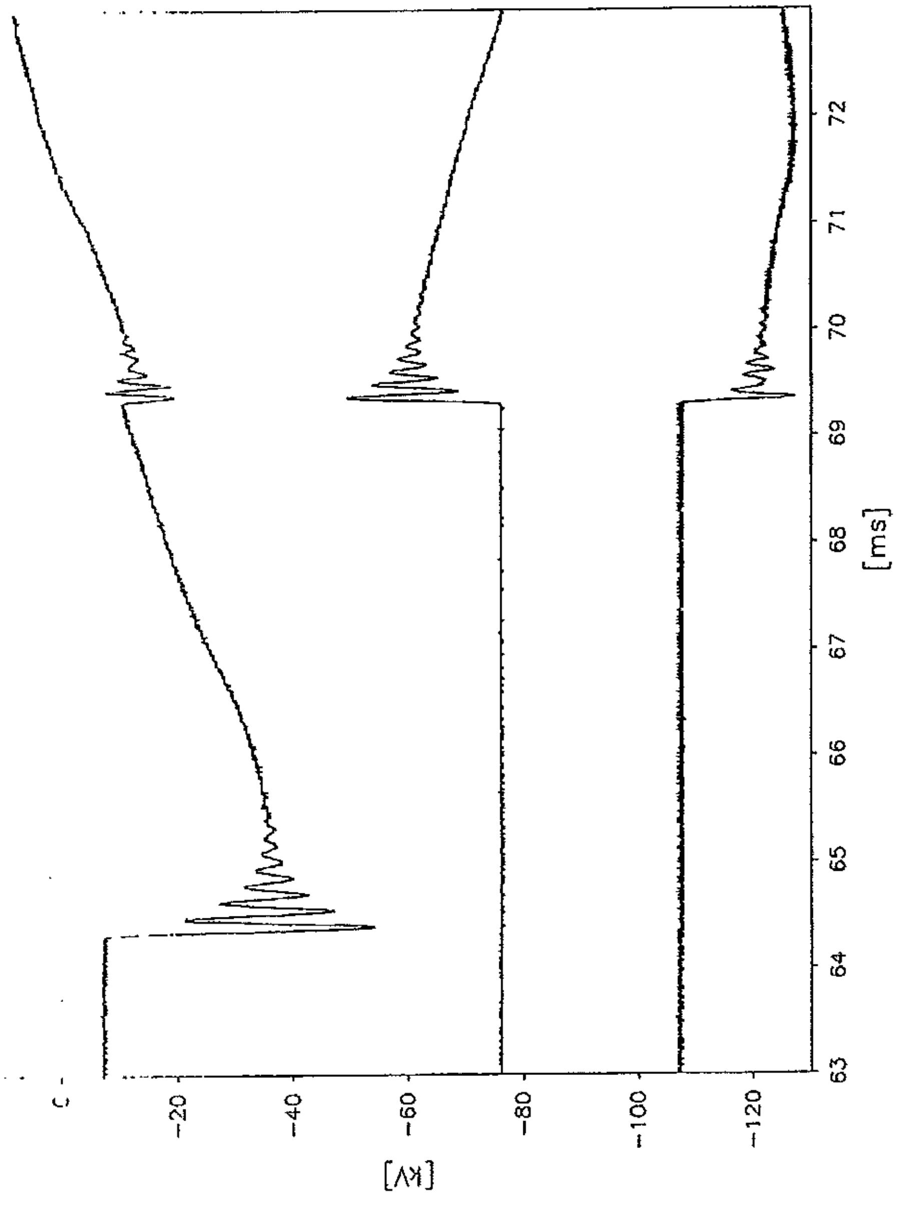
Condition of test object after test: The condition of the circuit-breaker after the test series corresponds to the conditions given in clause 6.102.9.4 of IEC 62271-100 / Ed. 1.1 / 2003-05. Visual inspection, no-load measurements before and after the test series, measurements of the resistance of the main circuit before and after the test series as well as a power frequency voltage check according to clause 6.2.11 of IEC 62271-100 / Ed. 1.1 / 2003-05 (with 80% and 100% of the rated power frequency withstand voltage) after the test series are carried out to prove the condition of the circuit-breaker.

Oscillogram
PEHLA 0511Ra / 29



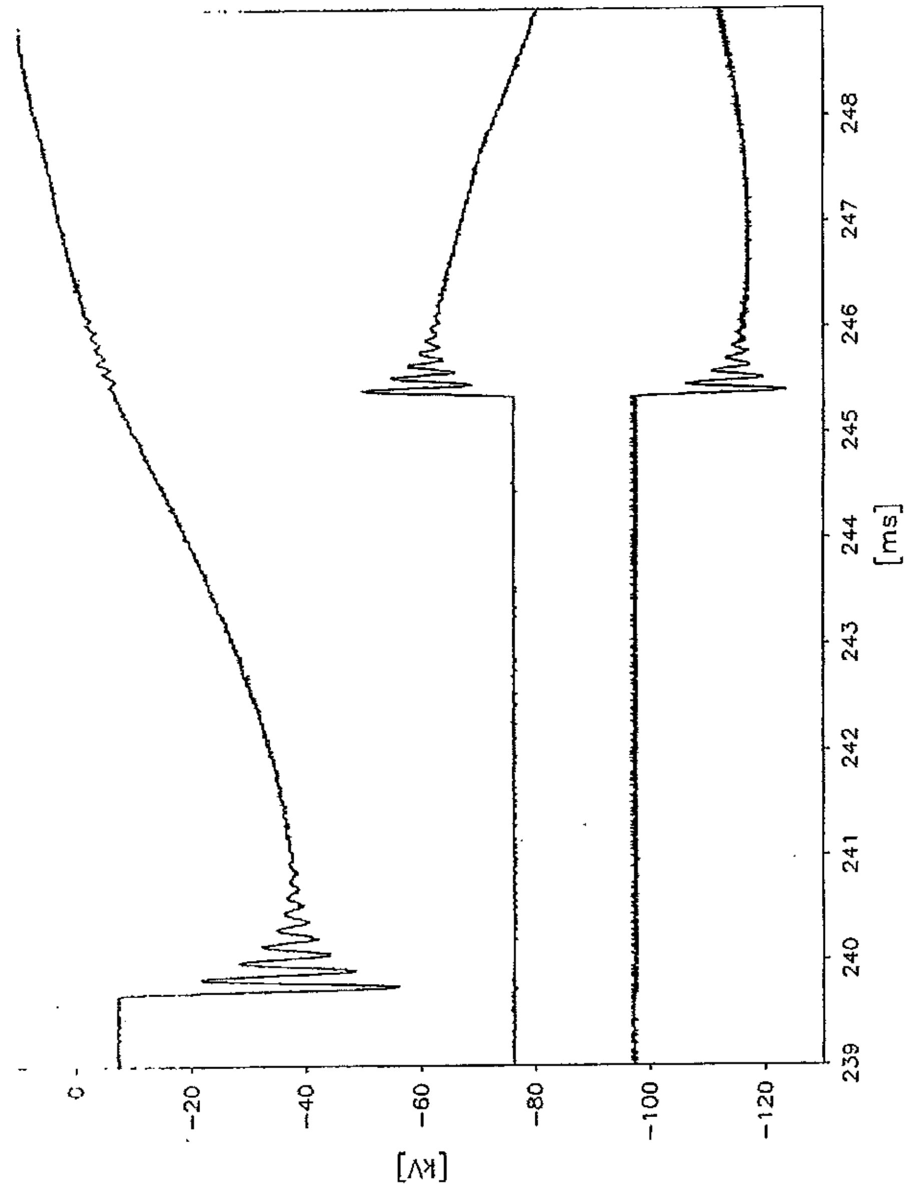
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 29



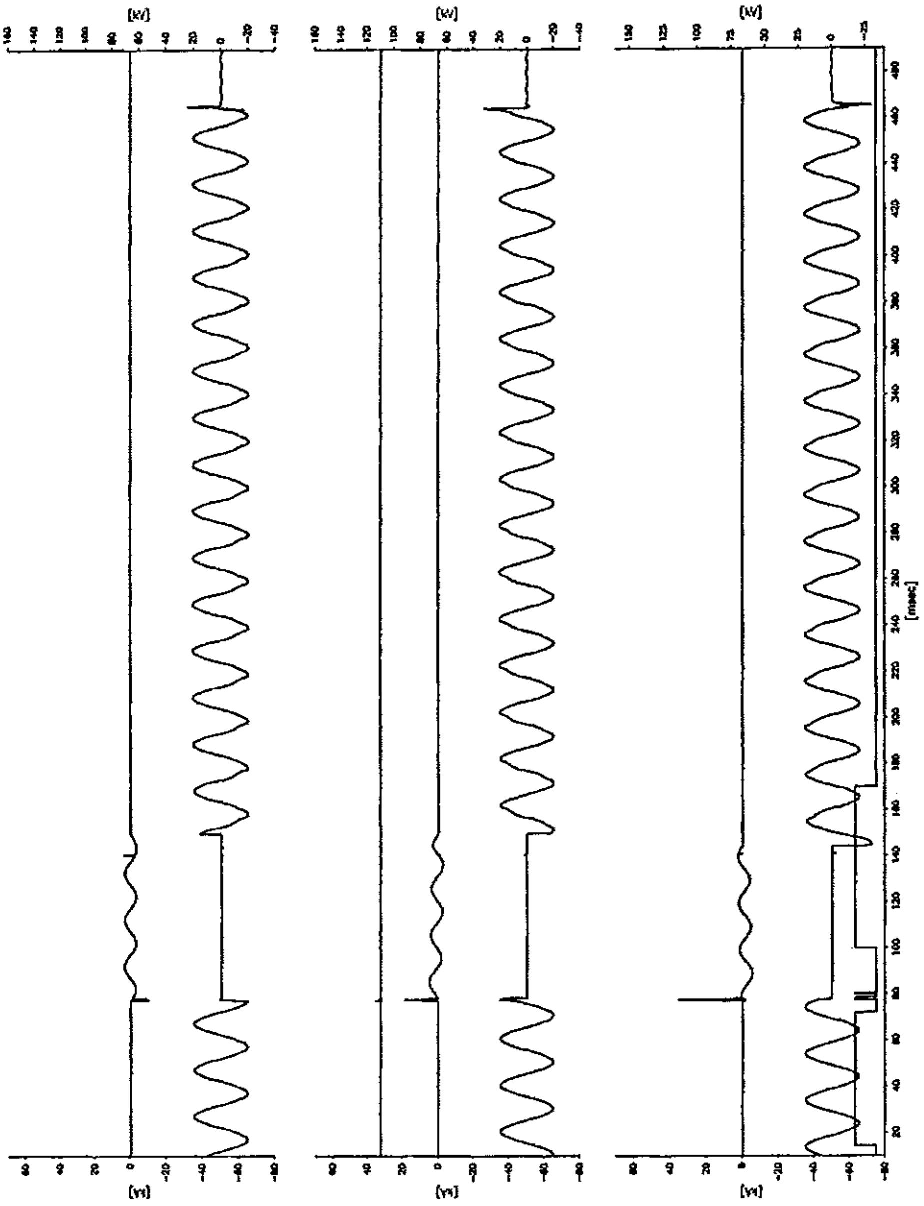
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 29



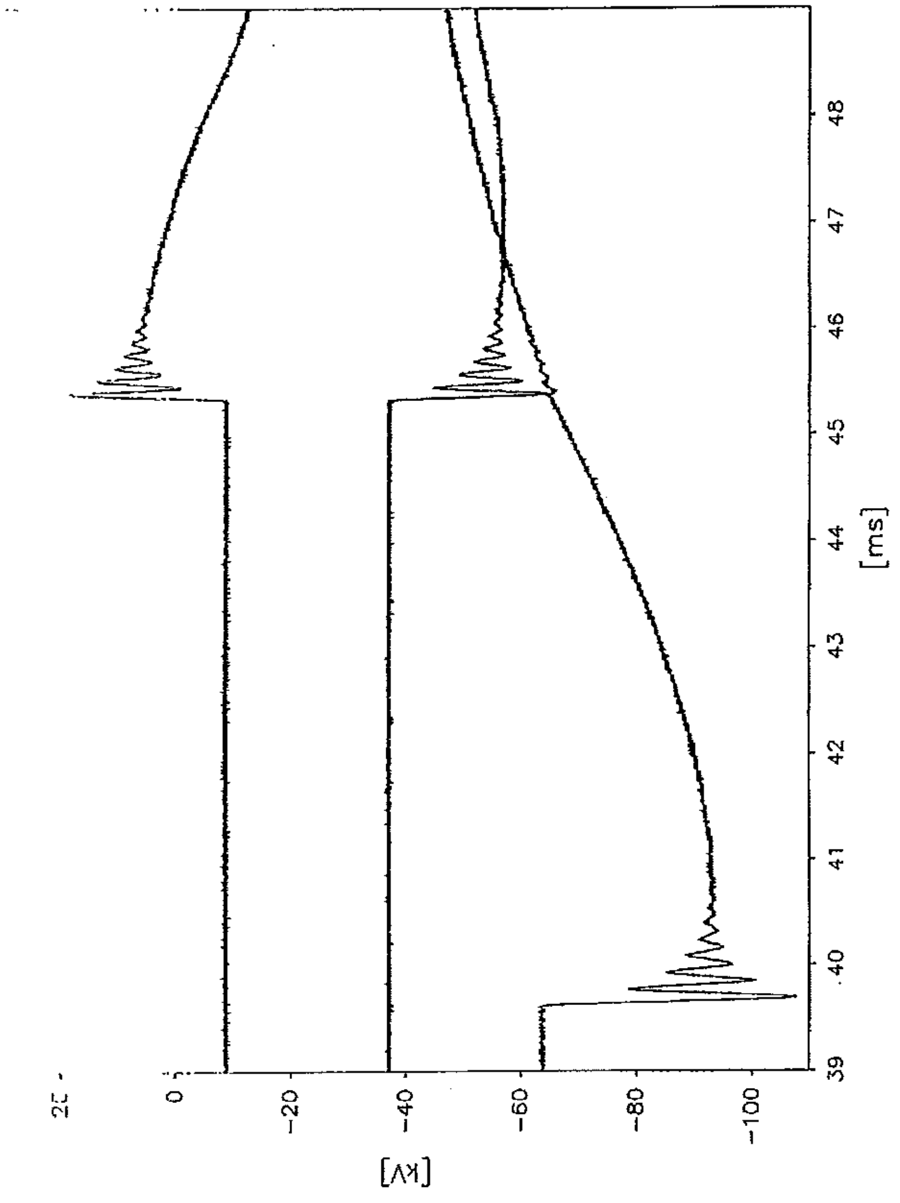
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 30



Oscillogram

PEHLA 0511Ra / 30



ВЯРНО С ОРИГИНАЛА

Test Results

No-load Operations

Test performed: No-load operation
Date of test: 09th March 2005
Condition of test object before test: As after Test PEHLA 0511Ra / 05.

Test No. PEHLA 0511Ra				06		06A		06B	
Operating sequence				O – 0.3s – CO		O – 0.3s – CO		O – 0.3s – CO	
C-Operation	Voltage of closing device		V	-	110	-	121	-	94
	Closing time	L1	ms	-	59.6	-	57.6	-	63.6
		L2	ms	-	59.8	-	57.8	-	63.8
		L3	ms	-	59.6	-	57.4	-	63.4
O-Operation	Voltage of opening device		V	110	110	121	121	77	77
	Opening time	L1	ms	46.0	45.6	43.2	43.8	61.0	60.0
		L2	ms	45.8	45.4	43.0	43.6	60.8	59.8
		L3	ms	46.0	45.6	43.2	43.8	60.8	60.0

Remarks: The voltage values correspond to 100% of the rated supply voltage in Test PEHLA 0511Ra / 06, 110% in Test PEHLA 0511Ra / 06A and 70% (O) resp. 85% (C) in Test PEHLA 0511Ra / 06B.

Test performed: No-load operation
Date of test: 10th March 2005
Condition of test object before test: As after Test PEHLA 0511Ra / 30.

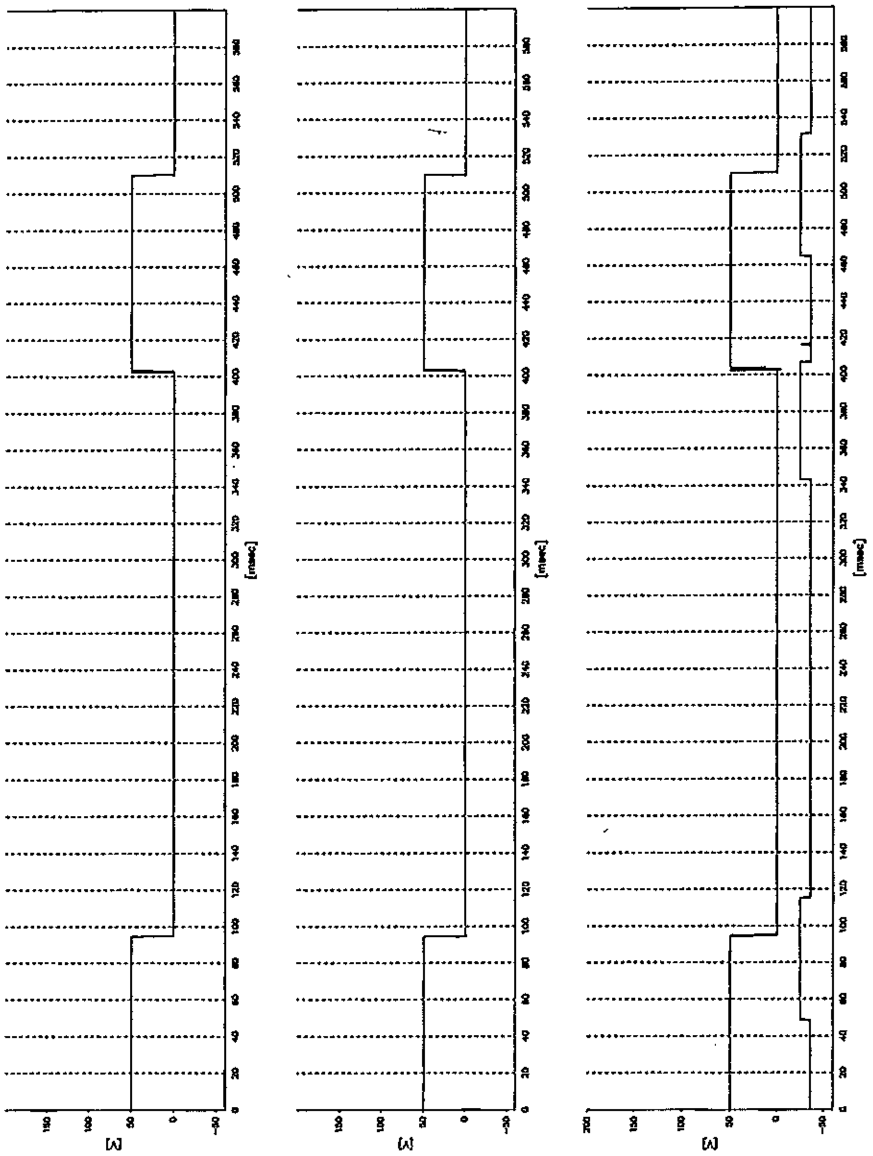
Test No. PEHLA 0511Ra				31		31A		31B	
Operating sequence				O – 0.3s – CO		O – 0.3s – CO		O – 0.3s – CO	
C-Operation	Voltage of closing device		V	-	110	-	121	-	94
	Closing time	L1	ms	-	60.6	-	58.6	-	64.8
		L2	ms	-	60.6	-	58.6	-	64.8
		L3	ms	-	60.0	-	58.0	-	64.2
O-Operation	Voltage of opening device		V	110	110	121	121	77	77
	Opening time	L1	ms	46.2	46.0	43.6	43.0	58.8	57.8
		L2	ms	45.8	45.6	43.2	42.6	58.4	57.2
		L3	ms	46.4	46.2	43.8	43.4	59.0	58.0

Remarks: The voltage values correspond to 100% of the rated supply voltage in Test PEHLA 0511Ra / 31, 110% in Test PEHLA 0511Ra / 31A and 70% (O) resp. 85% (C) in Test PEHLA 0511Ra / 31B.

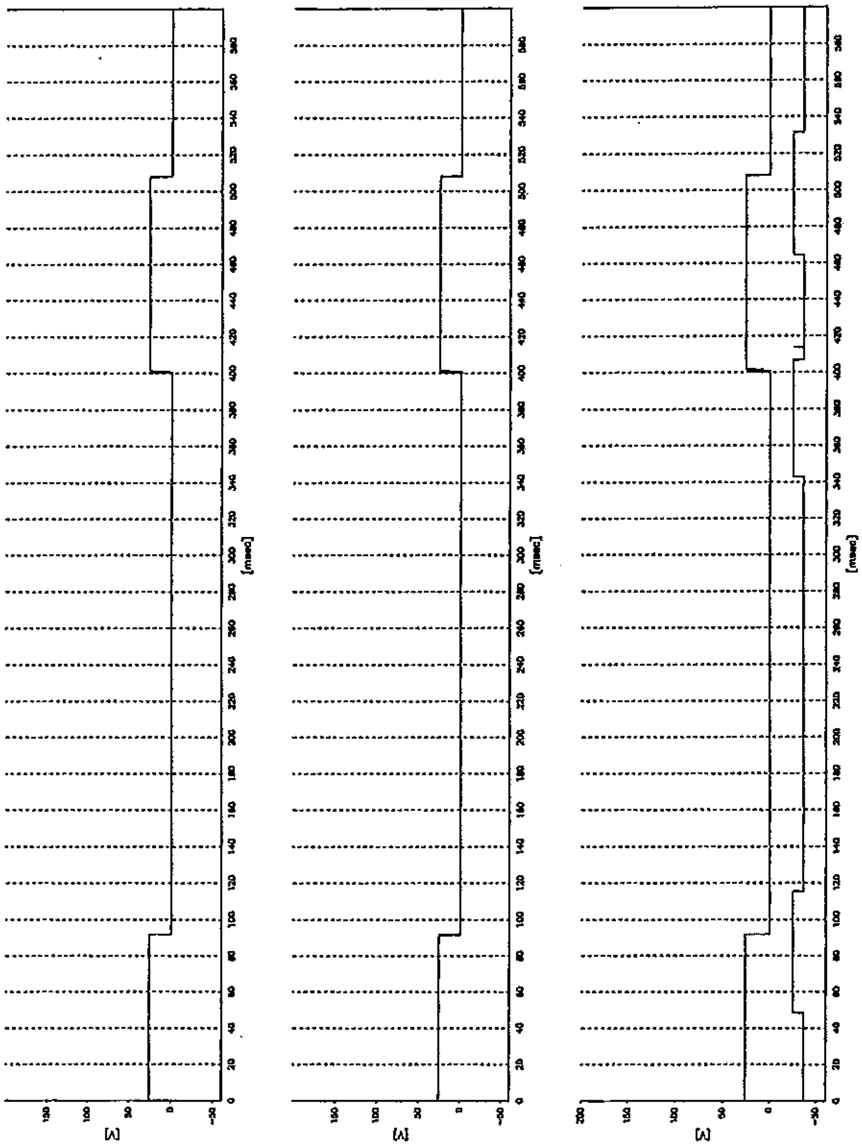
ВЯРНО С ОРИГИНАЛА

Oscillogram

PEHLA 0511Ra / 06

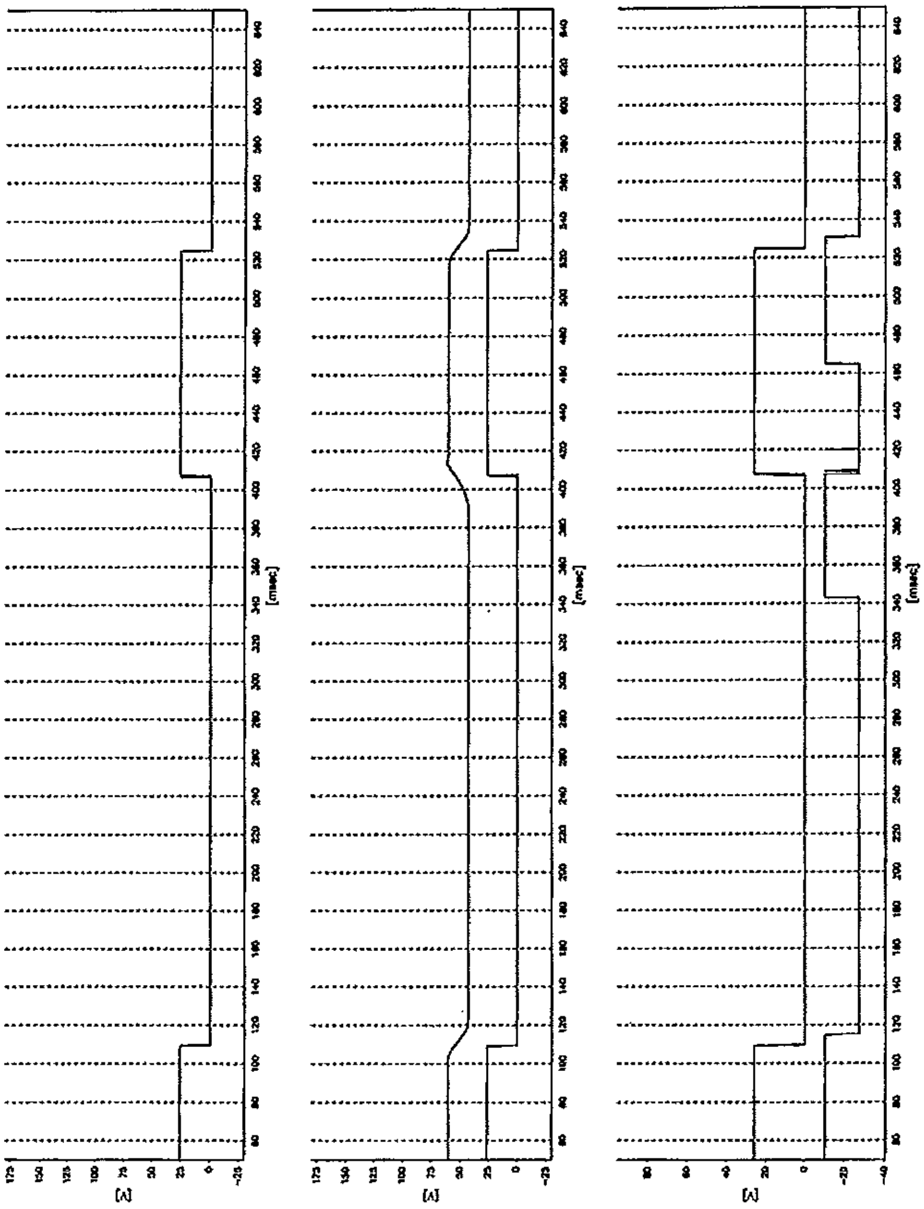


Oscillogram
PEHLA 0511Ra / 06A

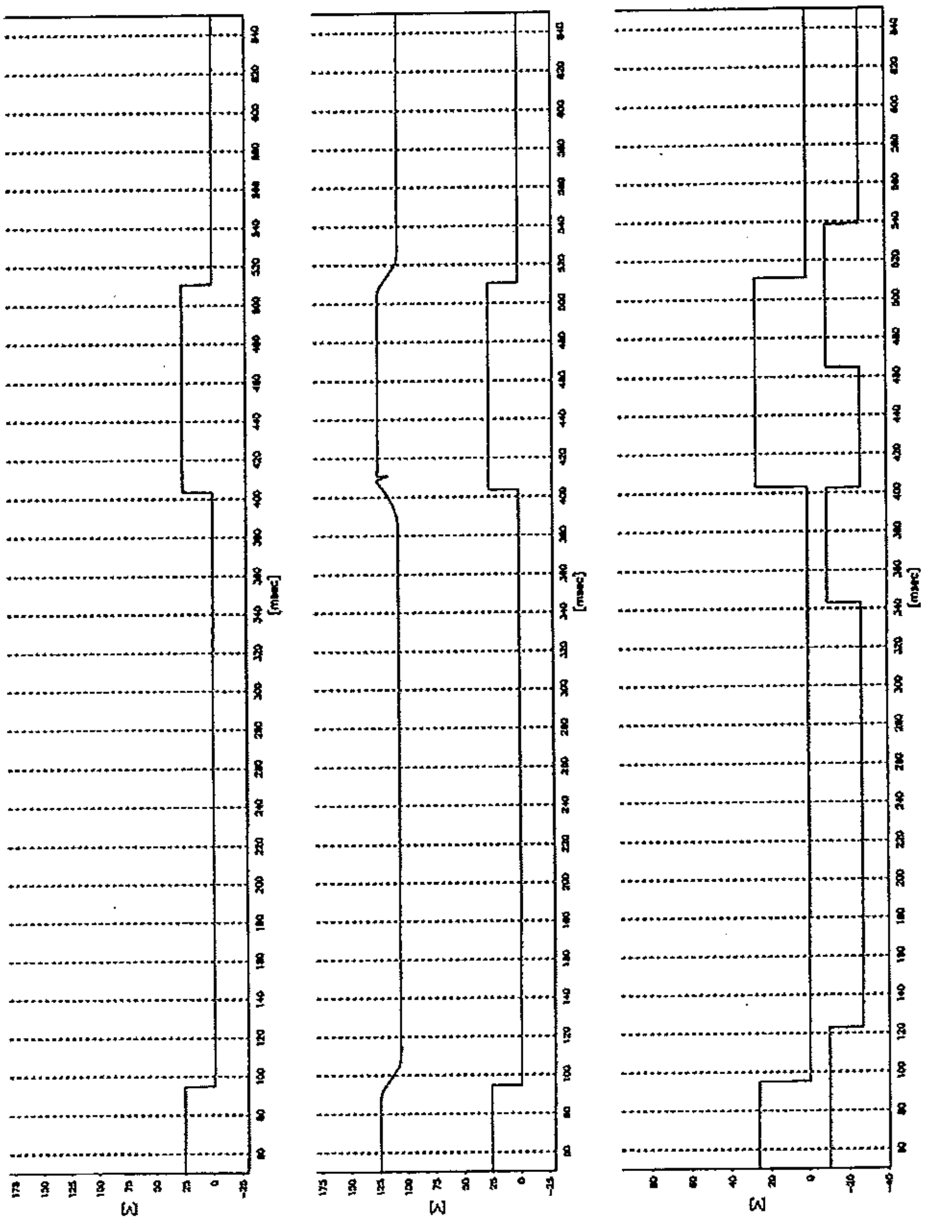


ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 06B

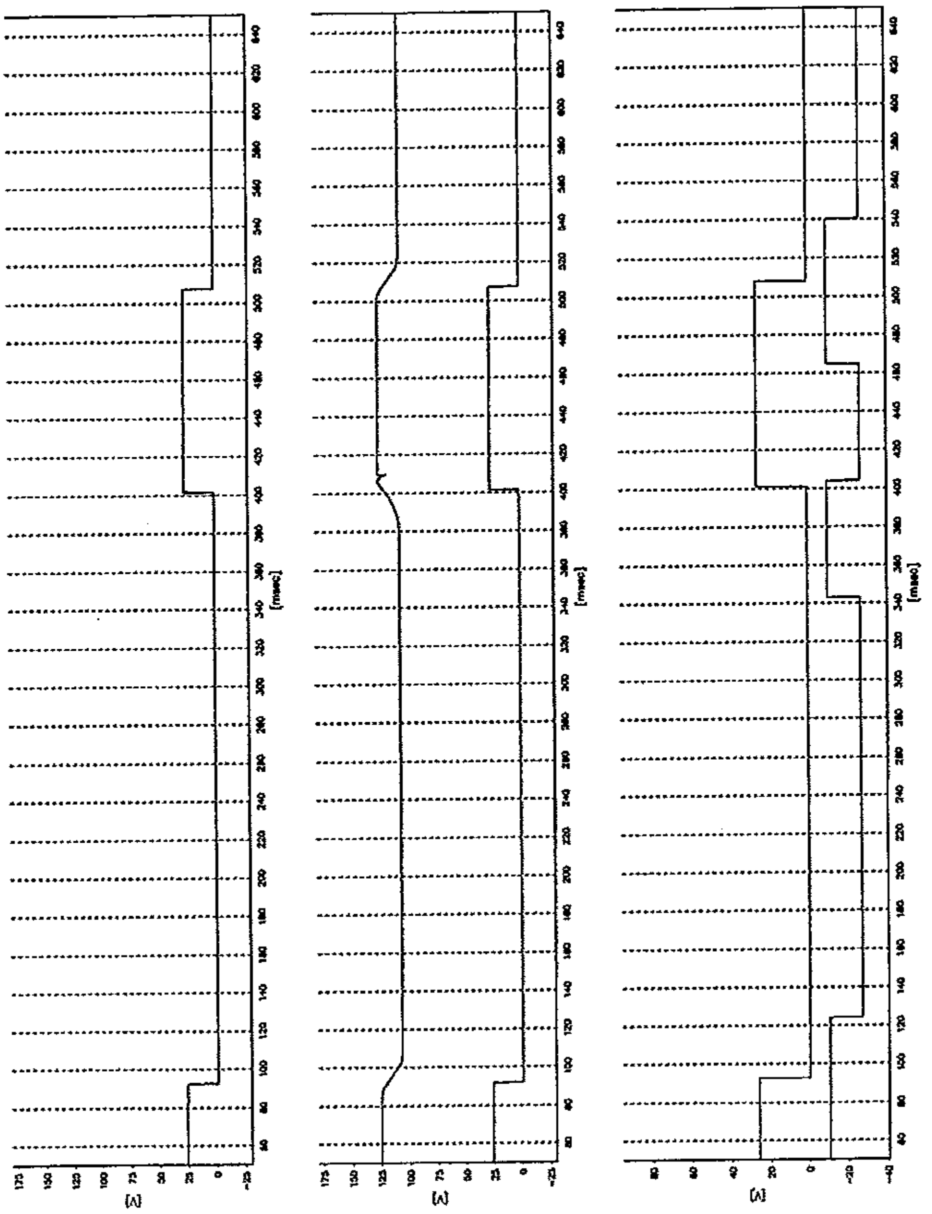


Oscillogram
PEHLA 0511Ra / 31



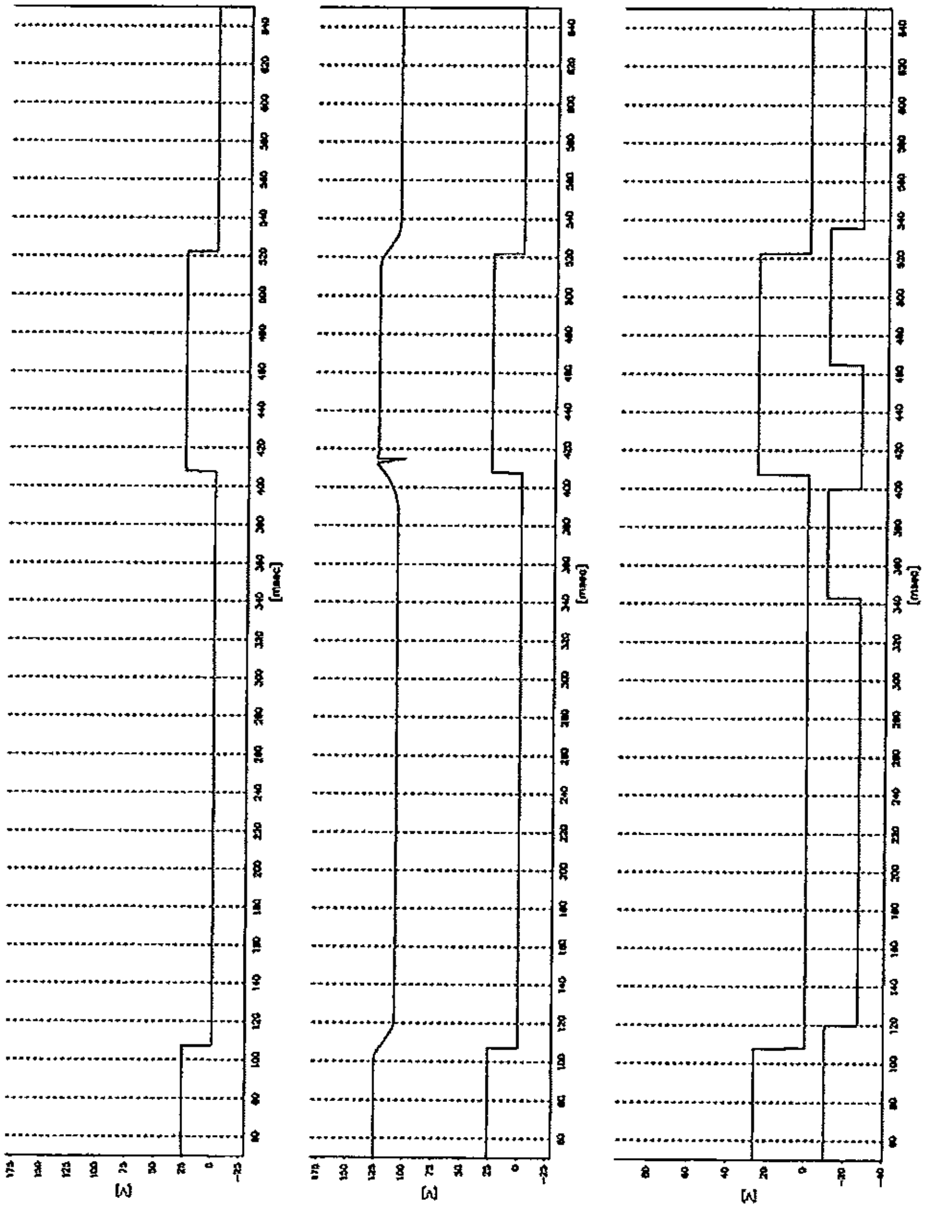
ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 31A



ВЯРНО С ОРИГИНАЛА

Oscillogram
PEHLA 0511Ra / 31B



ВЯРНО С ОРИГИНАЛА

Test Results

Voltage Test as a Condition Check

Test performed:	Voltage test as a condition check according to IEC 62271-100 Subcl. 6.2.11
Date of test:	10th March 2005
Condition of test object before test:	As after test PEHLA 0511Ra / 31
Test arrangement:	High voltage test transformer connected to the contact arms of the circuit-breaker
Connections to test object:	Connection of high voltage to one contact arm of the open poles via copper wire ∅ 0.5 mm, the other contact arm earthed via copper wire ∅ 0.5 mm

Test arrangement			Test voltage	Result
Condition	Voltage applied to	Earthed	kV	
-	-	-	40.0 – 1 min	ok
-	-	-	50.0 – 1 min	ok

Remarks: -

Condition of test object after test: No visible or functional change or damage.

Measurement of the Resistance of the Main Circuit

Test performed: Measurement of the Resistance of the Main Circuit

Date of test: 09th March 2005

Condition of test object: As after Test PEHLA 0511Ra / 06.

Measurement before test No. PEHLA 0511Ra / 07

Ambient air temperature: 21.0 °C

Resistance measurement at direct current of: 100 A (d.c.)

Measurement between points (see sheet 70)	Resistance of the main circuit μΩ		
	L1	L2	L3
1 - 2	26.2	27.1	26.2
-	-	-	-
-	-	-	-

Remarks: -

Date of test: 10th March 2005

Condition of test object: As after Test PEHLA 0511Ra / 30.

Measurement after test No. PEHLA 0511Ra / 31

Ambient air temperature: 21.0 °C

Resistance measurement at direct current of: 100 A (d.c.)

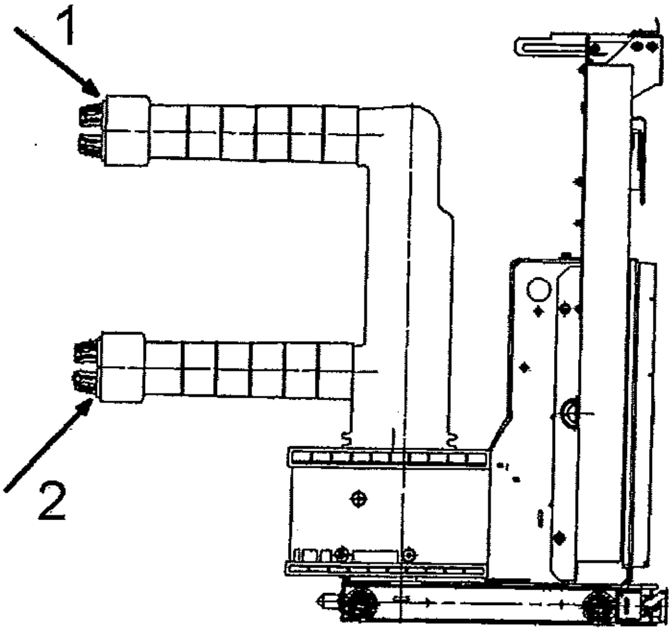
Measurement between points (see sheet 70)	Resistance of the main circuit μΩ		
	L1	L2	L3
1 - 2	32.2	36.8	29.7
-	-	-	-
-	-	-	-

Remarks: -

ВЯРНО С ОРИГИНАЛА

Measurement of the Resistance of the Main Circuit

Measurement points



ВЯРНО С ОРИГИНАЛА

Photos

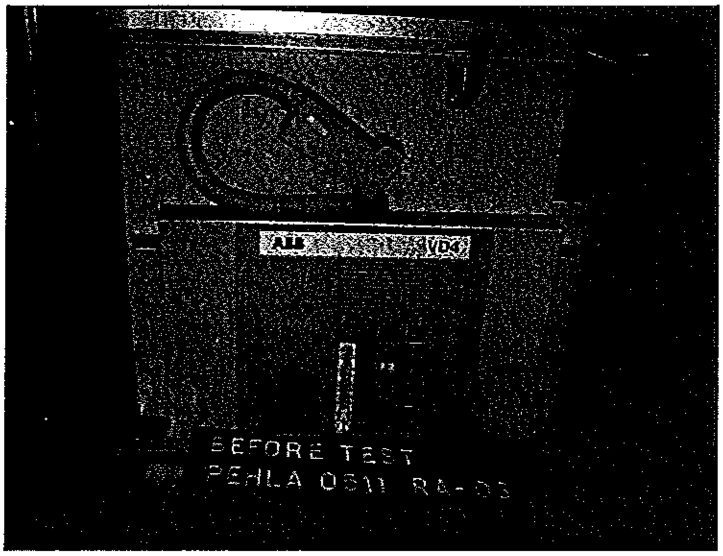


Photo No. 01
Before Test no. PEHLA 0511Ra / 03

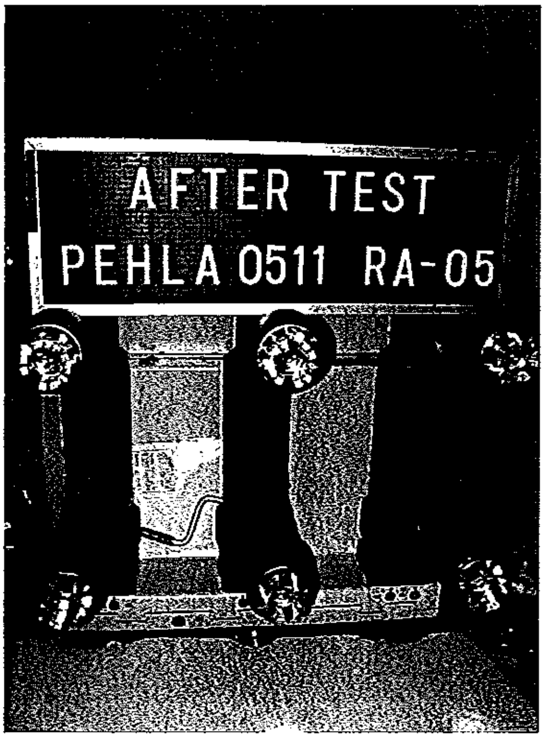


Photo No. 02
After Test no. PEHLA 0511Ra / 05

ВЯРНО С ОРИГИНАЛА

Photos

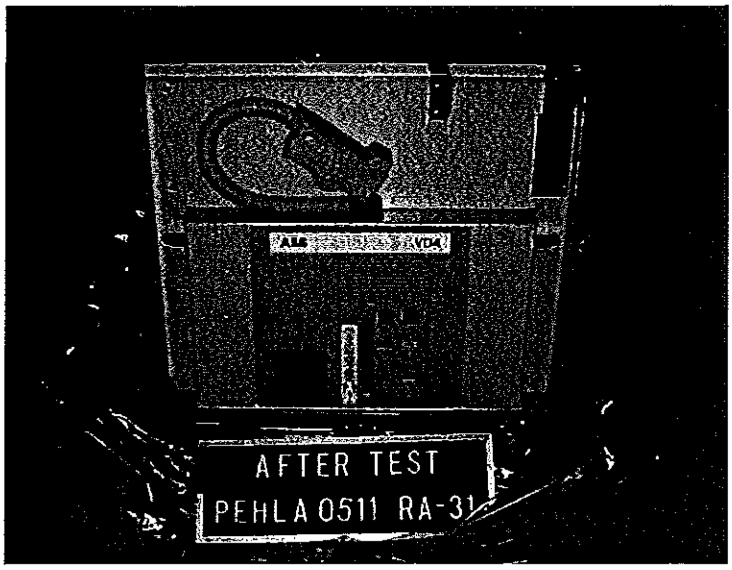


Photo No. 03
After Test no. PEHLA 0511Ra / 31

Photo No. 04
After Test no. PEHLA 0511Ra / 31

ВЯРНО С ОРИГИНАЛА

ABB Trasmissione & Distribuzione S.p.A.
Unità operativa Sace T.M.S.
Via Friuli 4
I 24044 – Dalmine (BG)
Italy

Tel.: 0039.035.395111
Fax: 0039.035.395874
E – mail: sacetms.tipm@it.abb.com
Internet: //www.abb.com

ABB

TYPE TEST DOCUMENTATION No. 100089_C Page 1/1

Apparatus: Metal-clad switchgear type ZS1 rel 1.2 with vacuum circuit-breaker type VD4/P 24.12.20 p=275

Identification: 1VCP0000138-Rev.-,en-Technical catalogue-2003-04

Performances:

Performances:	Rated voltage :	24	kV
	Rated lightning impulse withstand voltage :	125	kV
	Rated power-frequency withstand voltage :	50	kV
	Rated frequency :	50-60	Hz
	Rated normal current (busbar) :	1250	A
	Rated normal current (tee-off) :	1250	A
	Rated peak withstand current :	63	kA
	Rated short-time withstand current :	20	kA
	Rated duration of short circuit :	3	s

Test reports verifying rating assigned by the manufacturer:

Performances	Test according to	Test reports	
		No.	Issued by
Dielectric test	IEC 60298 Subclausole 6.1	0045 Ra	PEHLA High-power Laboratories
Temperature-rise test	IEC 60298 Subclausole 6.3/6.4	HZ 236 E06	Calor Emag Laboratories
Short-time and peak withstand current test	IEC 60298 Subclausole 6.5	HZ 235 F01	Calor Emag Laboratories
Mechanical operation and interlock test	IEC 60298 Subclausole 6.102	MZ 235 A01	Calor Emag Laboratories
Internal arc test	IEC 60298 Annex AA	HZ 235 L02	Calor Emag Laboratories
Mechanical operation test	IEC 62271-100 subclause 6.101.2	0311 Ra	PEHLA High-power Laboratories
Making and breaking capacity test	IEC 62271-100 subclause 6.106	0511 Ra	PEHLA High-power Laboratories

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CESI Laboratories Milano are accredited according UNI CEI EN ISO/IEC 17025 by SINAL under Reg. No. 030

Date of issue:
04/09/16

Development Dept.
G.M. Cravanzola

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ВЯРНО С ОРИГИНАЛА

Deutscher Akkreditierungs Rat
DAR
Reg.-Nr.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 235 F 01

Sheet 1

Issued by an Accredited Laboratory
corresponding to EN 45001

Copy-No. 1e

Test Object

One feeder panel (1000 mm width) of metal-clad, air-insulated switchgear type ZS1.2 equipped with a circuit-breaker type VD4P 2420-25 and an earthing switch type EK6-ZS1-2406-275

Rated voltage	U_r	24	kV
Rated normal current busbar / tee-off	I_r	2500/1600	A
Rated frequency	f_r	50/60	Hz
Rated peak withstand current	I_p	63	kA
Rated short-time withstand current	I_k	25	kA
Rated duration of short-circuit current	t_k	3	s
Rated short-circuit breaking capacity at 24 kV	I_{sc}	25	kA

Manufacturer

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Tests performed

Three-phase peak withstand and short-time withstand current tests of the main circuit and the earthing switch.
For further details see sheet-no. 2.

Test Specification

The tests have been carried out in accordance with the client's instructions.
Test procedure and test parameters were based on:
IEC 60694/2nd Ed./1996-05/Clause 6.6,
IEC 60298/3rd Ed./1990-12/Clause 6.5,
IEC 60129/3rd Ed./1984/Clause 6.5,
IEC 60056/4th Ed./1987/Clause 6.5.

Test Results

The switchgear, the vacuum circuit-breaker and the earthing switch passed the above mentioned peak withstand and short-time withstand current tests successfully.

Test Date

14th September 2000

Client

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

07th February 2002
Date of Issue

Dr. Stefan Göttlich
Laboratory Manager

Diergardt
Karl-Hermann Diergardt
Test Engineer

Total Number of Sheets: 20 Sheets (Test Report) + 6 Sheets (Oscillograms)

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373 - 03

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT-P-032/93

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ВЯРНО С ОРИГИНАЛА

Tests performed:

Main circuit with vacuum circuit-breaker type VD4P 2420-25

Infeed by means of copper conductors to the cable terminals of the panel. Short-circuit bridge mounted on the bushings of busbar system outside the panel.

Three-phase peak withstand current tests up to 65.8 kA and short-time withstand current tests up to 25.5 kA - 3.03 s equivalent to 25.6 kA – 3 s.

(Oscillograms HZ 235 F 01 / 04 and 05)

Earthing switch type EK6-ZS1-2406-275

Infeed by means of copper conductors to the cable terminals of the panel. Short-circuit made by the earthing switch.

Three-phase peak withstand current tests up to 66.5 kA and short-time withstand current tests up to 25.1 kA – 3.03 s equivalent to 25.2 kA – 3 s.

(Oscillograms HZ 235 F 01 / 08 and 09)

Contents

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear

Test Object: Metal-clad, air-insulated switchgear

Type: ZS1.2 (1000 mm width)

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 07550027/2015/00 **Year of manufacture:** 2000

Drawing No's.: See sheet-no. 7

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated current busbar	2500	A
Rated current tee-off	1600	A
Rated short-circuit peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	1	s

Additional specifications and data:

- Current transformers 1600 / 5 / 5 A in cable compartment

Type	Serial-no. of the transformers		
	L1	L2	L3
ABB / TPU 65.11	058243	058244	058245

Date of receipt of test object: 12th September 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching device

Test Object: Vacuum circuit-breaker

Type: VD4P 2420-25

Vacuum interrupter: VG4S series no.: L1: G4 01196, L2: G4 01192, L3: G4 01194

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 7008269/4002/00 **Year of manufacture:** 2000

Drawing No's.: See sheet-no. 7

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	2000	A
Rated short-circuit breaking current	25	kA
Rated short-circuit making current	63	kA
DC-component	35	%
Pole factor	1.5	
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated operating sequence	O-0.3 s-CO-3 min-CO	
Rated times of circuit-breaker:		
- opening time	≤ 40	ms
- closing time	≈ 60	ms
Number of poles	3	
Number of units per pole	1	
Rated auxiliary voltages:		
- voltage of trip coil	220	V-DC
- voltage of closing coil	220	V-DC
- voltage of motor	220	V-DC

Additional specifications and data: -

Date of receipt of test object: 12th September 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching device

Test Object: Earthing switch

Type: EK6-ZS1-2406-275

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 06/052/00 **Year of manufacture:** 2000

Drawing No's.: See sheet-no. 7

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	-	A
Rated short-circuit breaking current	-	kA
Rated short-circuit making current	63	kA
DC-component	-	%
Pole factor	-	
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated operating sequence	-	
Rated times of earthing switch:		
- opening time	-	ms
- closing time	-	ms
Number of poles	3	
Number of units per pole	1	
Rated auxiliary voltages:		
- voltage of trip coil	-	V-DC
- voltage of closing coil	-	V-DC
- voltage of motor	-	V-DC

Additional specifications and data: -

Date of receipt of test object: 12th September 2000

ВЯРНО С ОРИГИНАЛА

Table of Drawings of Test Objects

The drawings submitted for identification of the test object were stamped and signed by the test engineer.

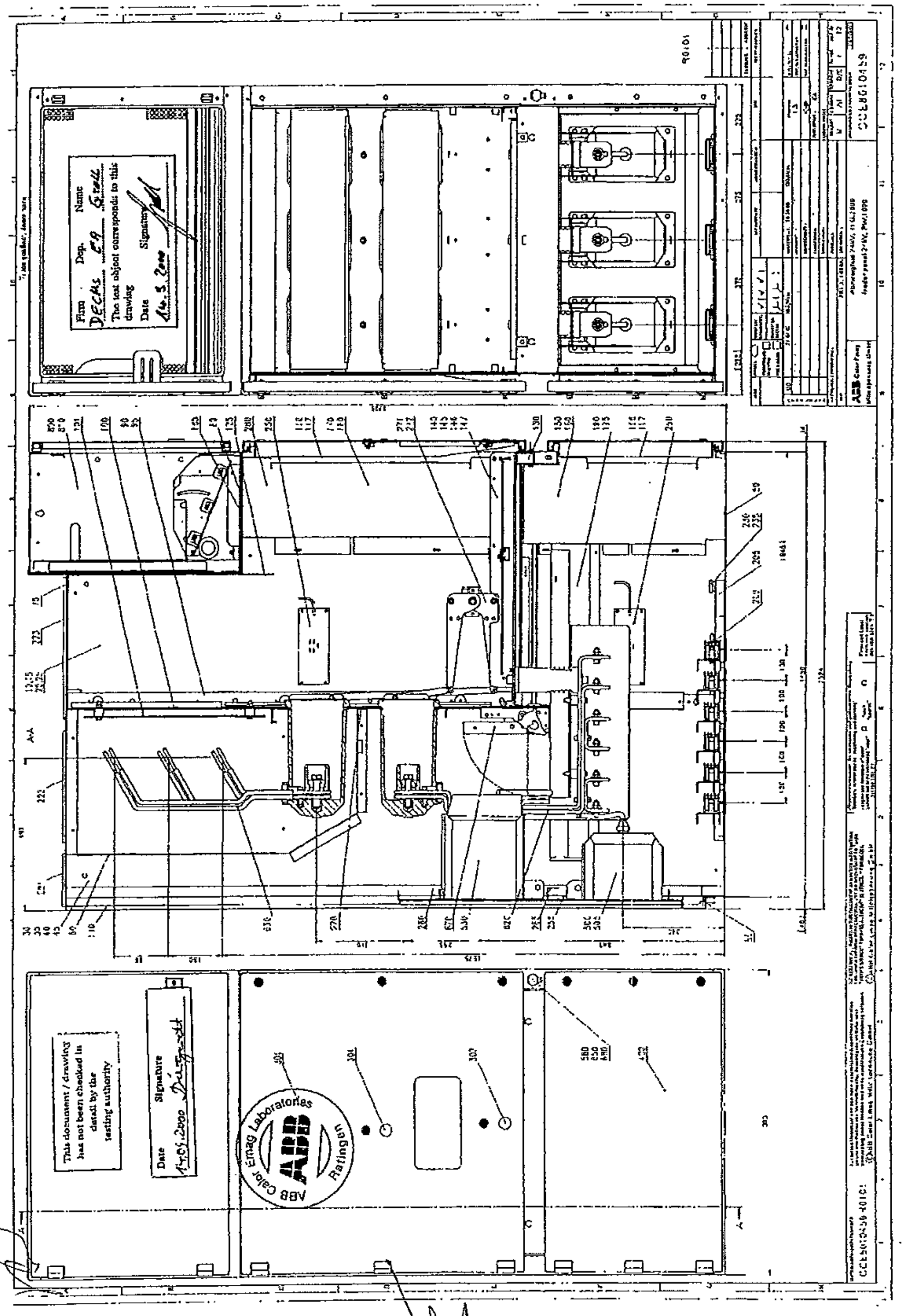
The manufacturer/client has guaranteed by signature on all drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

A copy of the following drawings is part of this Test Report:

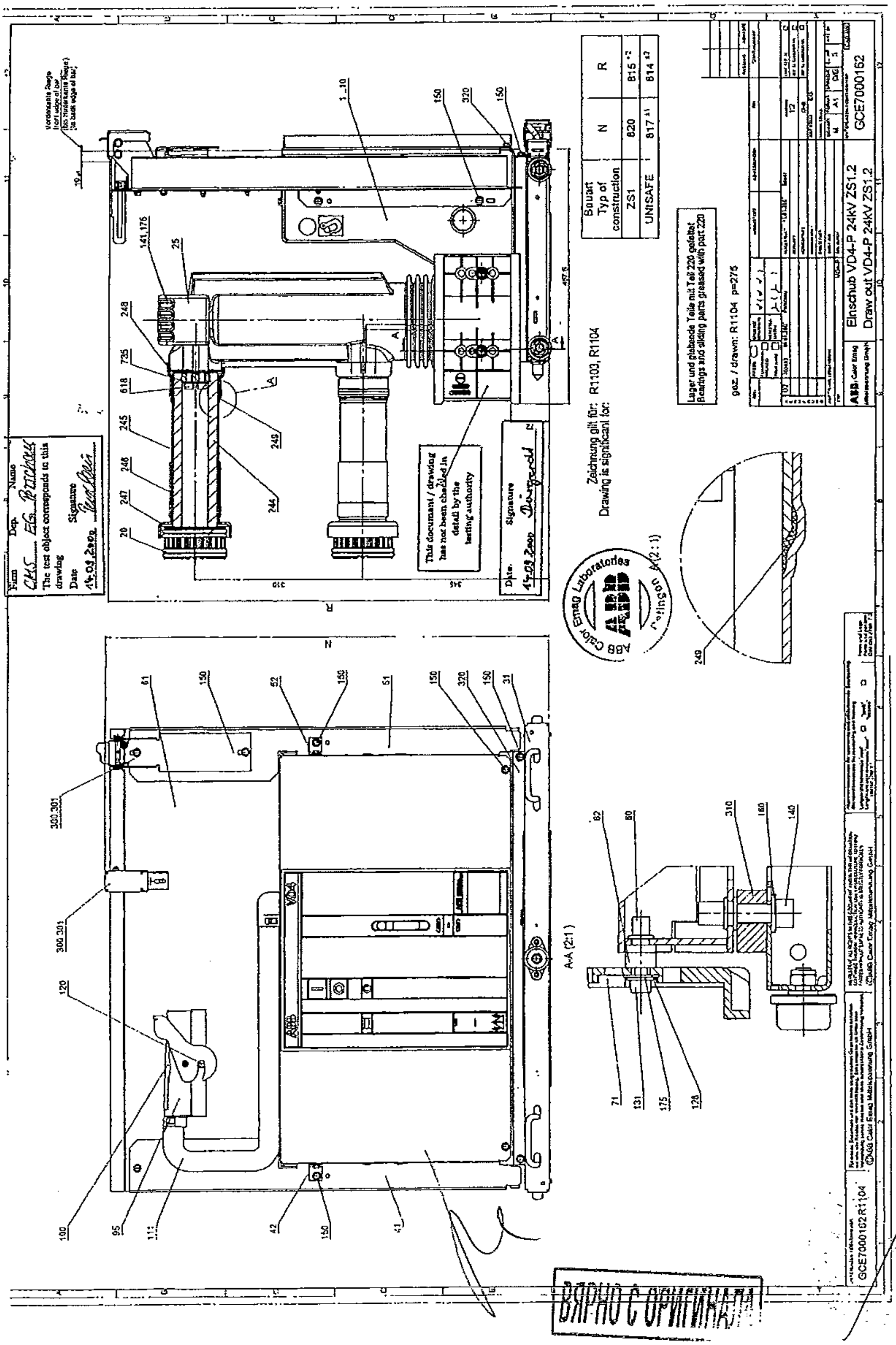
1. Panel ZS1.2, 24 kV, PW 1000	manufacturing type GCE8010459R0101 according to drawing-no. GCE8010459R0101, sheet-no. 1, index 00
2. Withdrawable circuit-breaker VD4P 2420-25	manufacturing type GCE7000162R1104 according to drawing-no. GCE7000162R1104, sheet-no. 5, index 02
3. Pole part	manufacturing type GCE7005757R0122 according to drawing-no. GCE7005757R0122, sheet-no. 221, index 00
4. Mechanism	manufacturing type GCE7179610R0104 according to drawing-no. GCE7179610R0104, sheet-no. 4, index 36
5. Earthing switch EK6-ZS1-2406-275	manufacturing type GCE7169312R0118 according to drawing-no. GCE7169312R0121, sheet-no. 1, index 24

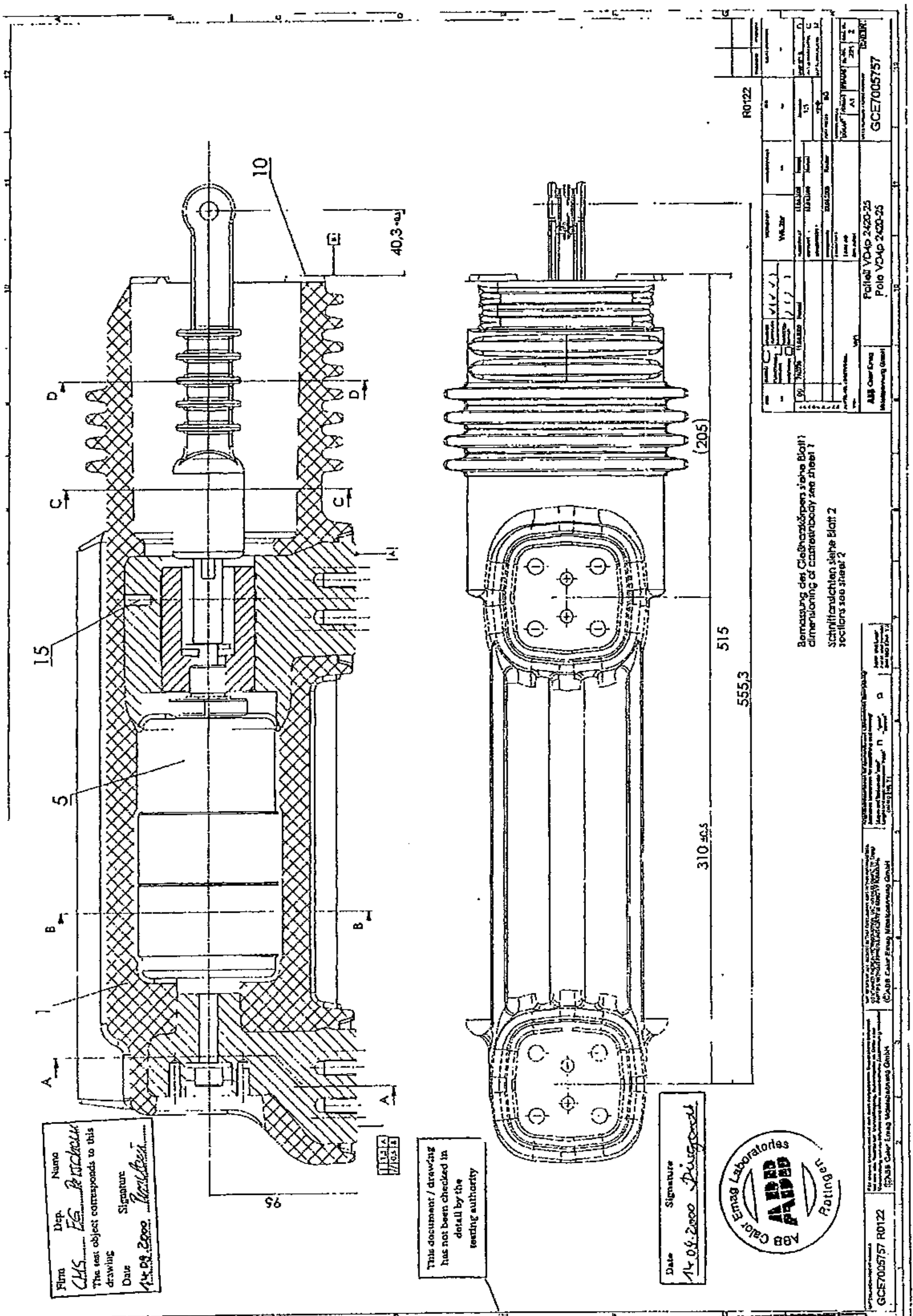
ВЯРНО С ОРИГИНАЛА

33



ВЯРНО С ОРИГИНАЛА


Bauart / Typ of construction
N
R
ZS1
820
815
UNISAFE
817
814
Zeichnung gilt für: R1103, R1104
Drawing is significant for:
Lager und gleitende Teile mit Teil 220 gefettet
Bearings and sliding parts greased with part 220
gez. / drawn: R1104 p=275
Einschub VD4-P 24kV ZS1.2
Draw out VD4-P 24kV ZS1.2
GCE7000162
GCE7000162R1104
This document / drawing has not been checked in detail by the testing authority
Firm
Dep.
Name
The test object corresponds to this drawing
Date
Signature
14.03.2000
ABB Calor Emag Laboratories Ratingen
A (2:1)
A-A (2:1)
N
R
1...10
150
320
141,175
25
248
735
618
245
246
247
20
249
244
61
52
51
31
300,301
120
100
95
111
42
41
62
80
71
131
175
128
310
160
140



Bemassung des Giessharzkörpers siehe Blatt 1
dimensioning of castresinbody see sheet 1

Schnittansichten siehe Blatt 2
sections see sheet 2

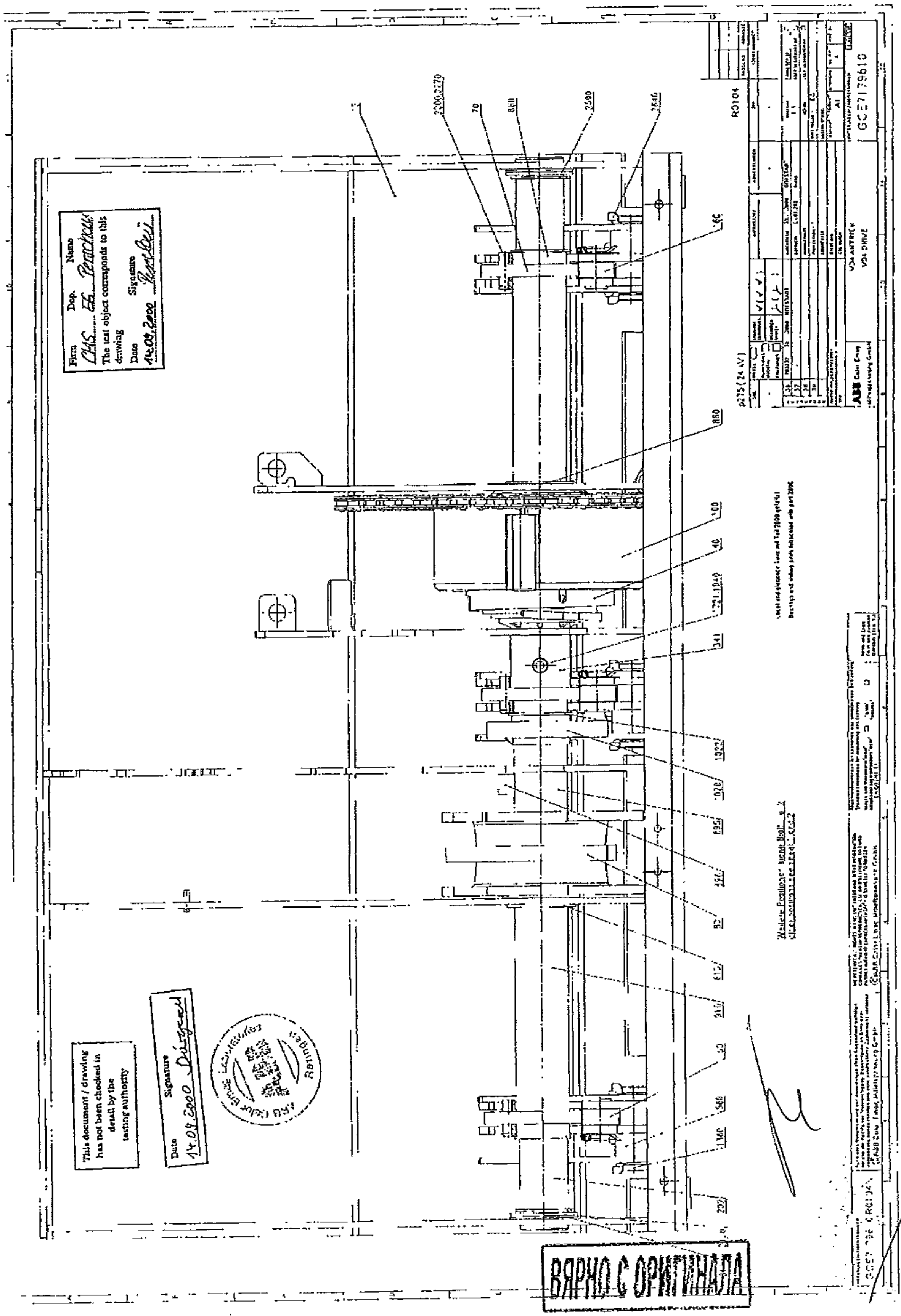
Firm: CHS
Dep.: EG
Name: Brückmann
The test object corresponds to this drawing
Date: 14.04.2000
Signature

This document / drawing has not been checked in detail by the testing authority

Date: 14.04.2000
Signature

ABB Calor Emag Laboratories Ratingen

ВЯРНО С ОРИГИНАЛА



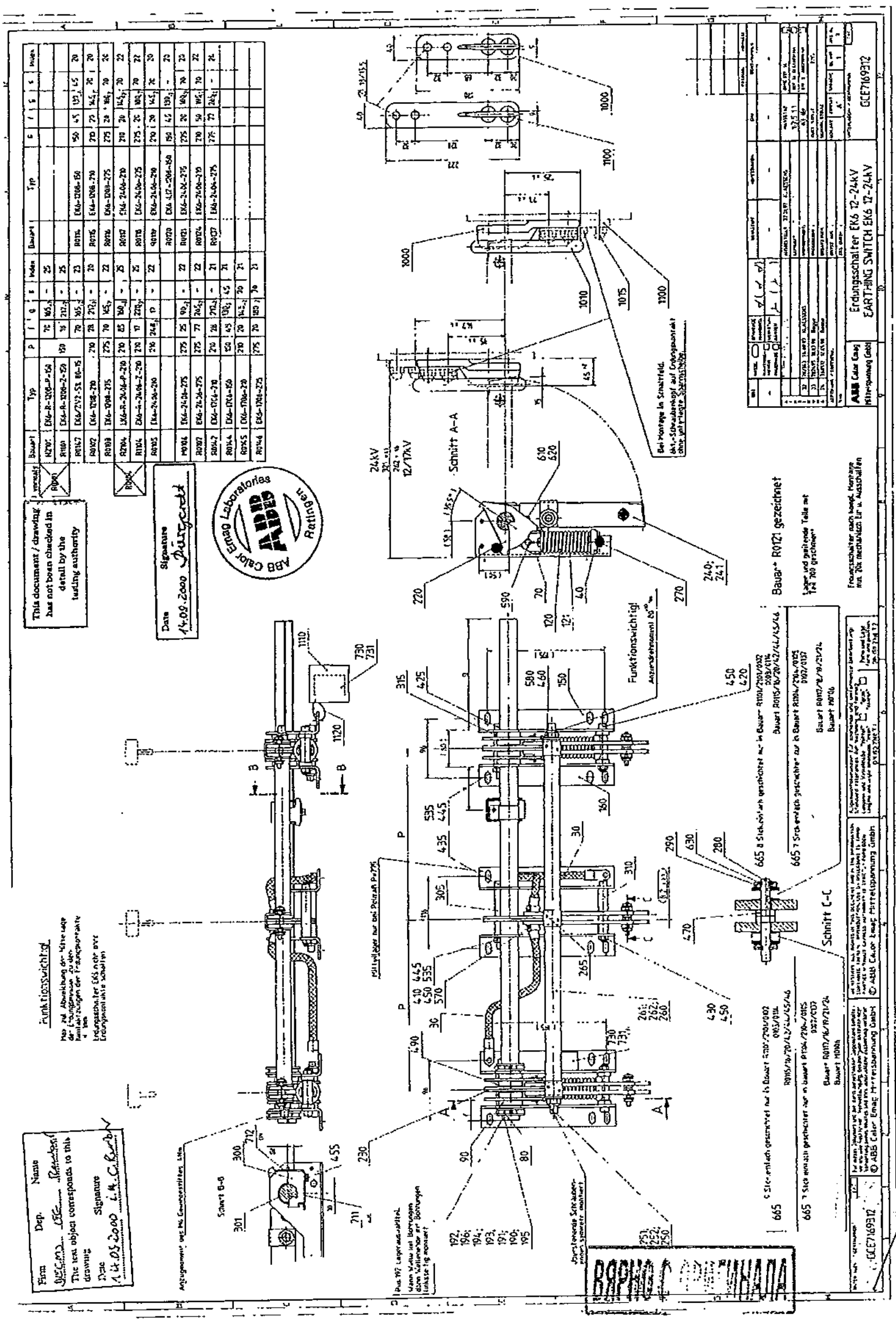
Firm CHS Dep. EE Name Penchev
The test object corresponds to this drawing
Date 14.04.2000 Signature

This document / drawing has not been checked in detail by the testing authority
Date 14.04.2000 Signature

ABB Calor Emag Laboratories Ratingen

ВЯРНО С ОРИГИНАЛА

3



This document / drawing has not been checked in detail by the testing authority

Date 14.09.2000 Signature Dürgardt

ABB Calor Emag Laboratories Ratingen

Firm Dep. Name
The test object corresponds to this drawing
Date 14.09.2000 Signature

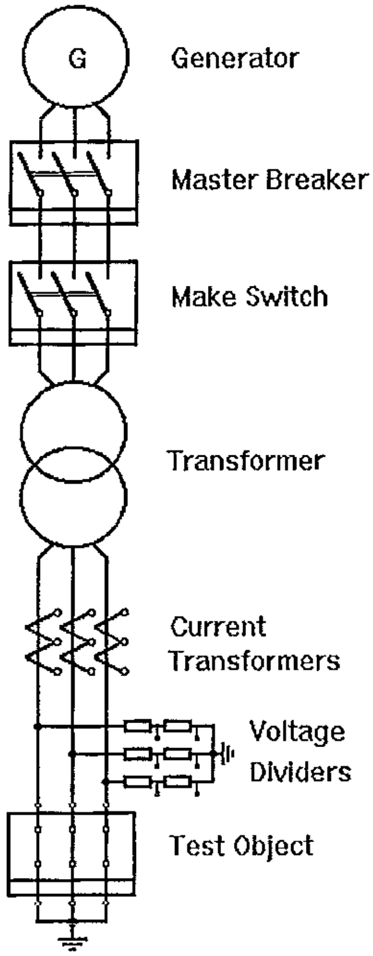
ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuit

Test		STC	--	--	--
Oscillogram-No. HZ 235 F 01		02 - 09	--	--	--
Number of phases	(circuit)	3	--	--	--
Number of poles/phases	(test object)	3	--	--	--
Power frequency	Hz	50	--	--	--
Power factor	cos φ	≤ 0.15	--	--	--
Earthing	Generator	earthed via 5 kΩ	--	--	--
	Transformer	not earthed	--	--	--
	Short-circuit point	earthed	--	--	--
Circuit diagram	Sheet no.:	14	--	--	--
Circuit impedance	mΩ	≈ 5	--	--	--
	--	--	--	--	--
TRV control elements		--	--	--	--
Capacitance in parallel	μF	--	--	--	--
Resistance in series	Ω	--	--	--	--
	-	--	--	--	--
	-	--	--	--	--
Prospective TRV	-	--	--	--	--
TRV peak value u_c	kV	--	--	--	--
Time co-ordinate t_3	μs	--	--	--	--
Time delay t_d	μs	--	--	--	--
Based on	kV	--	--	--	--
Rate-of-rise	kV/μs	--	--	--	--
	-	--	--	--	--
	-	--	--	--	--
Voltage measurements		Divider 75 kΩ / 1.1 kΩ	--	--	--
Current measurements		Transformer 50 kA / 5 A	--	--	--

Remarks: -

Principle Diagram of Test Circuit



ВЯРНО С ОРИГИНАЛА

Peak and Short-Time Withstand Current Tests

Actual values
(Main circuit)

Condition of test object before test: Switchgear and equipment new.

Connection to test object: By means of copper conductors to the cable terminals of the panel. Short-circuit bridge mounted on the bushings of busbar outside the panel. The circuit breaker closed.

Oscillogram-No. HZ 235 F 01				04	05	--	--
Peak short-circuit current		L1	kA	65.8	29.8	--	--
		L2	kA	53.6	28.1	--	--
		L3	kA	19.0	32.5	--	--
Short-circuit current	first cycle	L1	kA	27.8	26.2	--	--
		L2	kA	28.6	25.9	--	--
		L3	kA	26.3	25.2	--	--
	last cycle	L1	kA	26.2	25.9	--	--
		L2	kA	27.1	26.9	--	--
		L3	kA	25.3	25.0	--	--
Equivalent r.m.s. value		L1	kA	26.3	25.5	--	--
		L2	kA	27.3	26.4	--	--
		L3	kA	25.4	24.6	--	--
Average value			kA	26.3	25.5	--	--
Duration of short-circuit current			s	0.304	3.03	--	--
Short-time current	1 s	L1	kA	--	--	--	--
		L2	kA	--	--	--	--
		L3	kA	--	--	--	--
Average value			kA	--	--	--	--
Short-time current	3 s	L1	kA	--	25.6	--	--
		L2	kA	--	26.5	--	--
		L3	kA	--	24.7	--	--
Average value			kA	--	25.6	--	--

Remarks:
HZ 235 F 01 / 01: Current calibration
HZ 235 F 01 / 02: No-load operation
HZ 235 F 01 / 03: Test with reduced values
HZ 235 F 01 / 06: No-load operation

Condition of test object after test:
HZ 235 F 01 / 05: No visible change or damage. Circuit-breaker opened by its own mechanism at the first attempt.

ВЯРНО С ОРИГИНАЛА

Peak and Short-Time Withstand Current Tests

Actual values
(Earthing switch)

Condition of test object before test: Switchgear and equipment as after test 06.

Connection to test object: By means of copper conductors to the cable terminals. Short-circuit made by means of the closed earthing switch inside the panel. Circuit-breaker open in test position.

Oscillogram-No. HZ 235 F 01				08	09	–	–
Peak short-circuit current		L1	kA	66.5	34.1	–	–
		L2	kA	52.9	30.2	–	–
		L3	kA	19.1	36.2	–	–
Short-circuit current	first cycle	L1	kA	27.9	26.9	–	–
		L2	kA	27.9	26.3	–	–
		L3	kA	26.2	25.8	–	–
	last cycle	L1	kA	25.8	25.3	–	–
		L2	kA	26.0	25.6	–	–
		L3	kA	24.8	24.4	–	–
Equivalent r.m.s. value		L1	kA	26.1	25.4	–	–
		L2	kA	26.4	25.6	–	–
		L3	kA	25.1	24.4	–	–
Average value			kA	25.8	25.1	–	–
Duration of short-circuit current			s	0.302	3.03	–	–
Short-time current	1 s	L1	kA	–	–	–	–
		L2	kA	–	–	–	–
		L3	kA	–	–	–	–
Average value			kA	–	–	–	–
Short-time current	3 s	L1	kA	–	25.5	–	–
		L2	kA	–	25.7	–	–
		L3	kA	–	24.5	–	–
Average value			kA	–	25.2	–	–

Remarks:
HZ 235 F 01 / 07: Test with reduced values

Condition of test object after test:
HZ 235 F 01 / 09: No visible change or damage. Earthing switch could be opened easily by its own mechanism.

Actual Values of No-Load Operations

Rated supply voltage of closing coil 220 V dc
Rated supply voltage of opening coil 220 V dc

	Voltage of closing coil V	Closing time ms	Voltage of opening coil V	Opening time ms
Test HZ 235 F 01 / 02	--	--	220	36,4
Test HZ 235 F 01 / 06	--	--	220	37,4

Measurement of the Resistance of the Main-Circuit

Cable terminal against busbar outside the panel.

	Phase L 1	Phase L 2	Phase L 3
Before Test HZ 235 F 01 / 02	67.8 μΩ	60.4 μΩ	54.5 μΩ
After Test HZ 235 F 01 / 06	61.1 μΩ	60.0 μΩ	56.4 μΩ

ВЯРНО С ОРИГИНАЛА

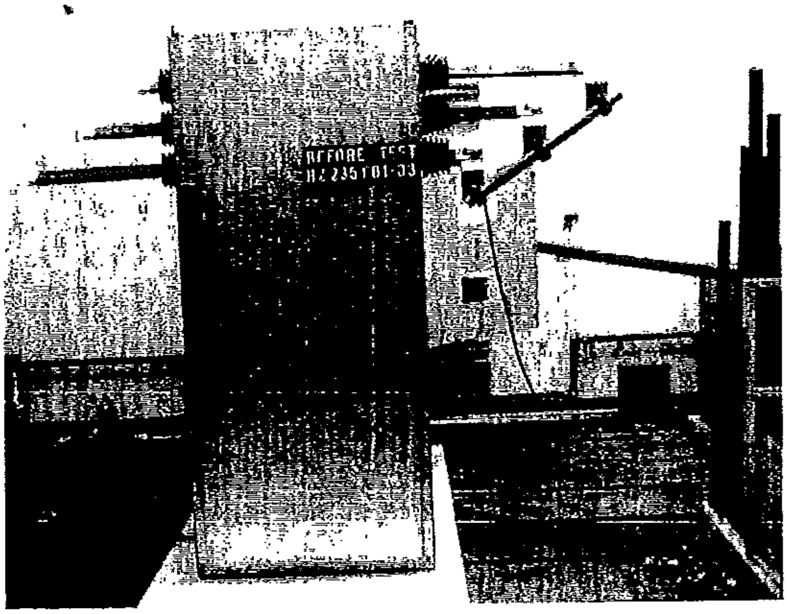
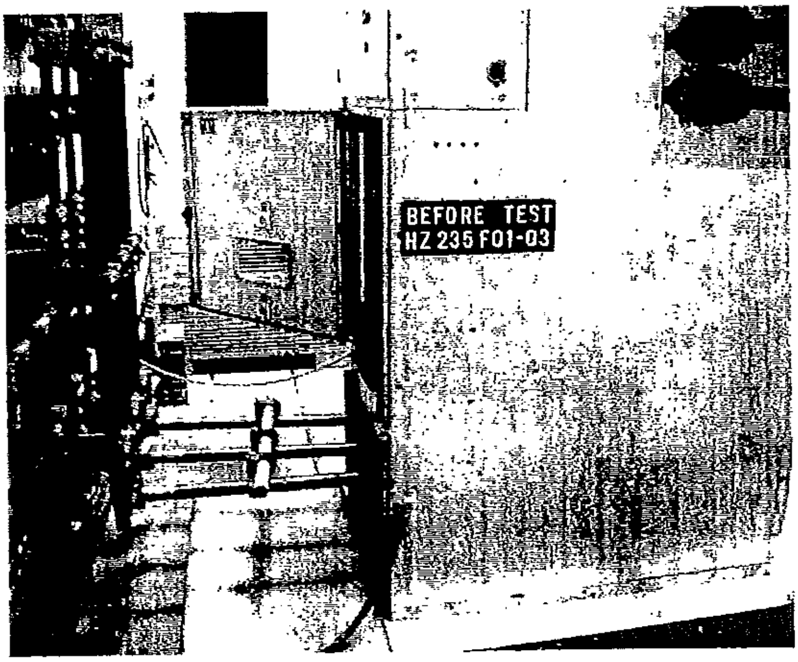


Photo no. 1
Before Test HZ 235 F 01 / 03



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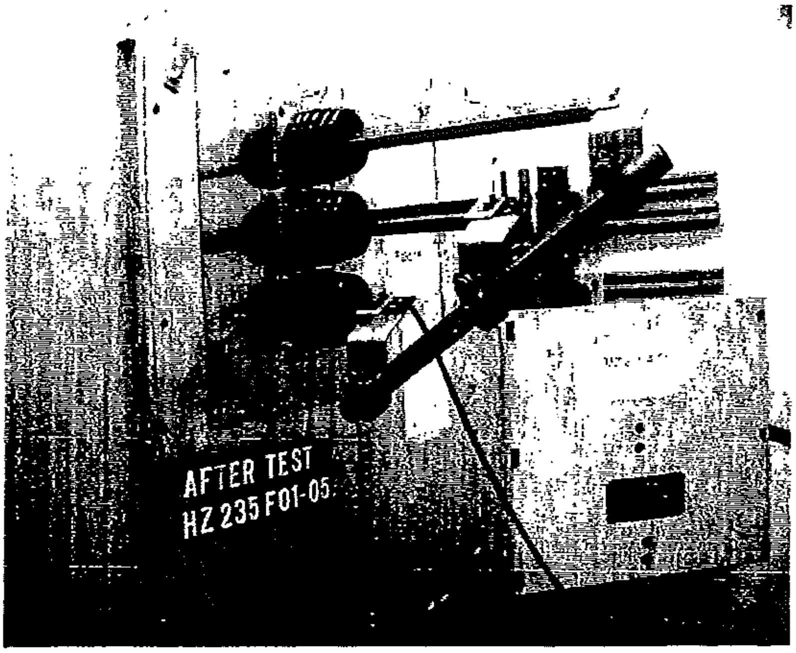
Before Test HZ 235 F 01 / 03



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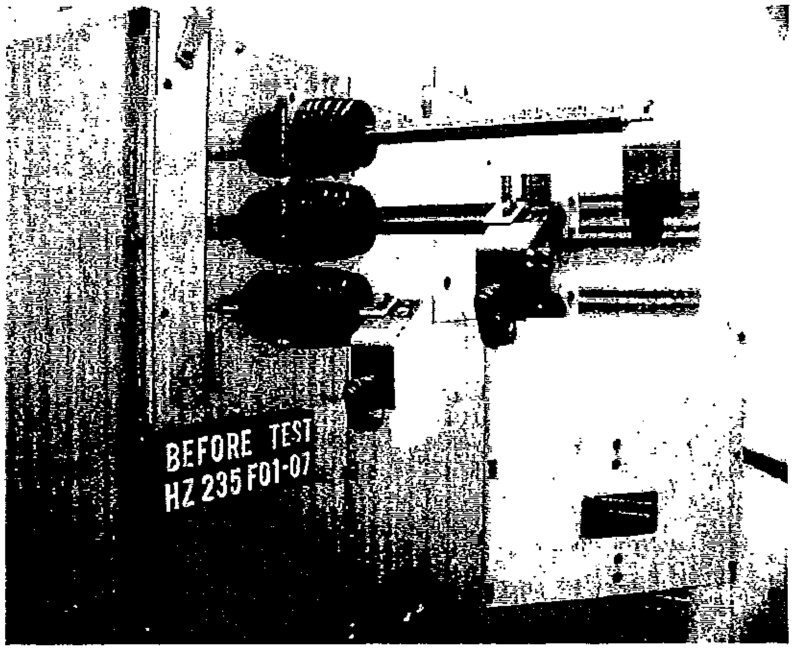

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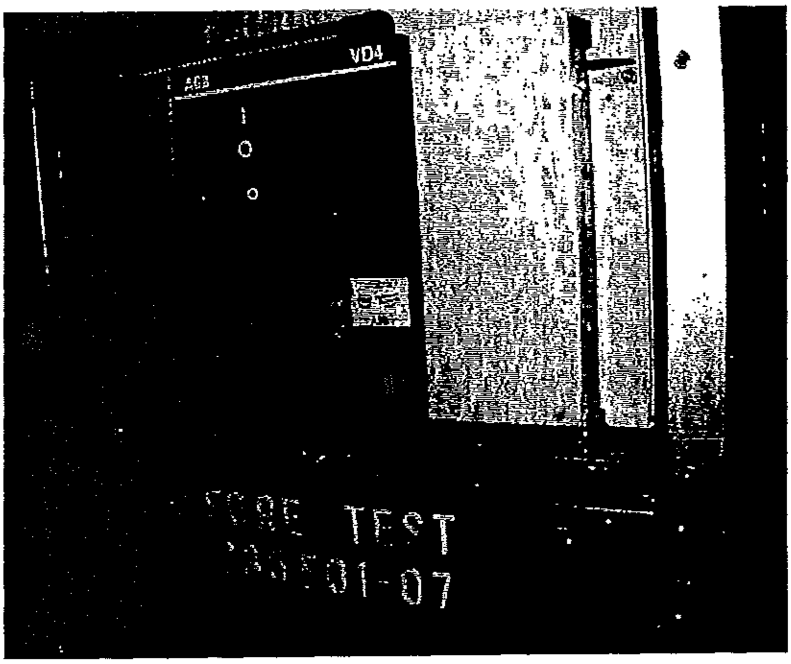

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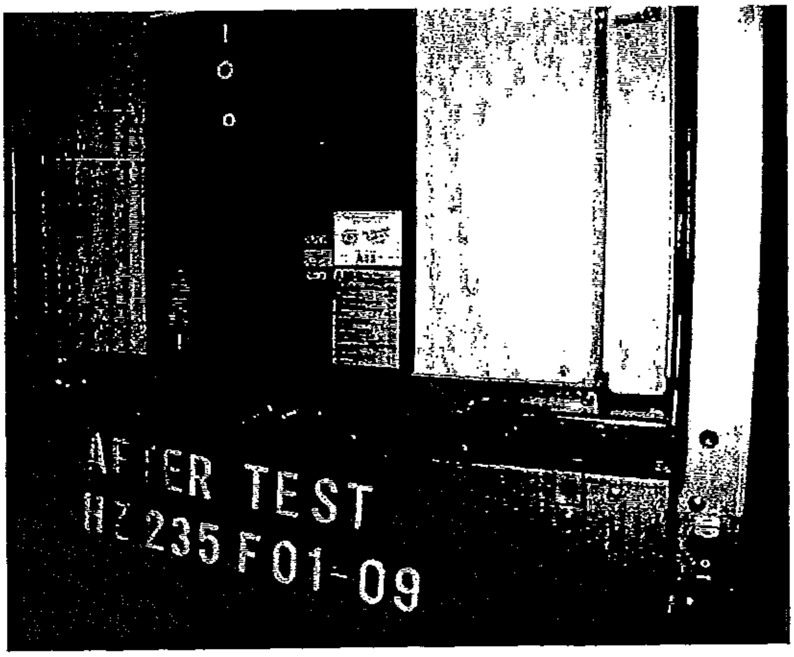
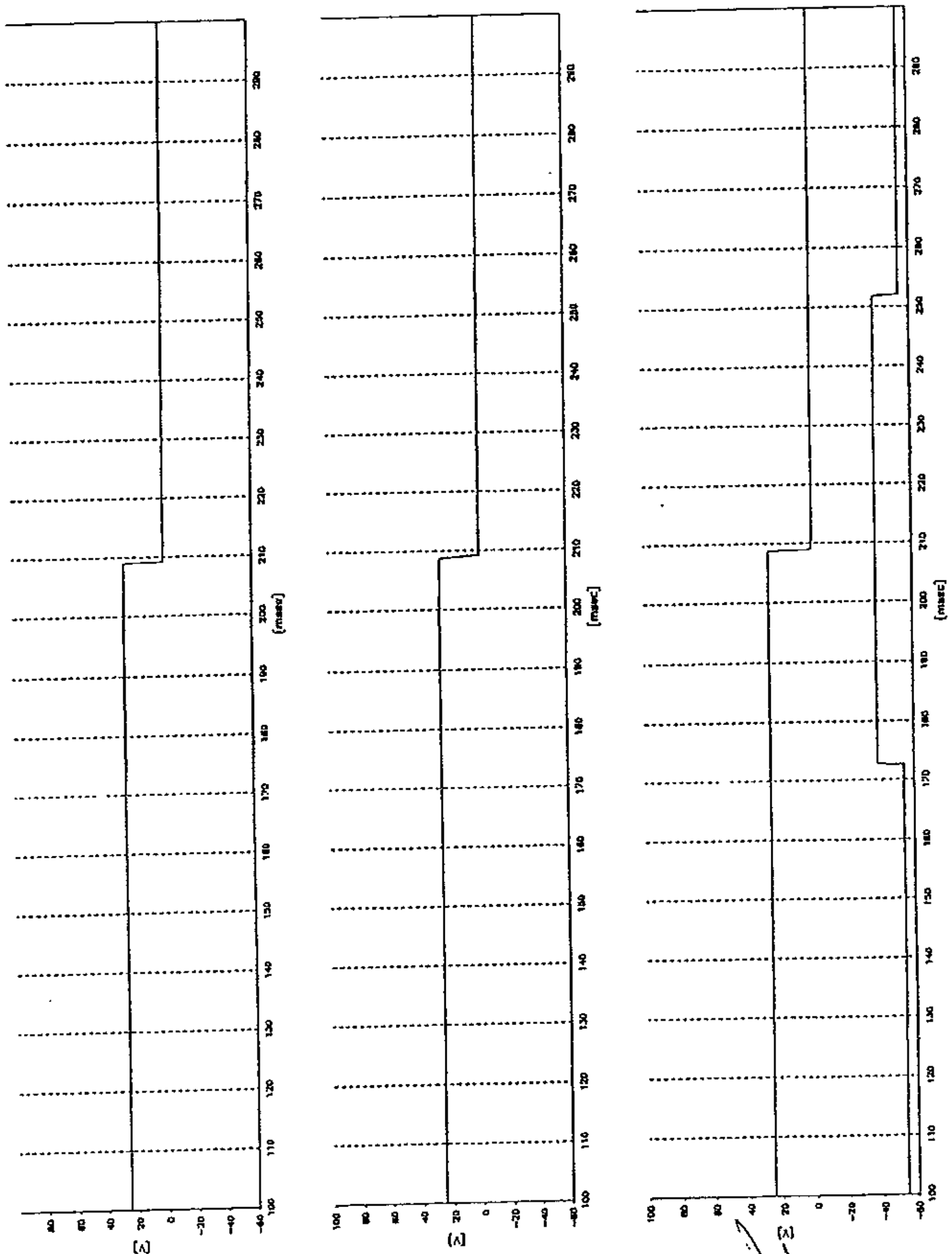


Photo no. 6
After Test HZ 235 F 01 / 09

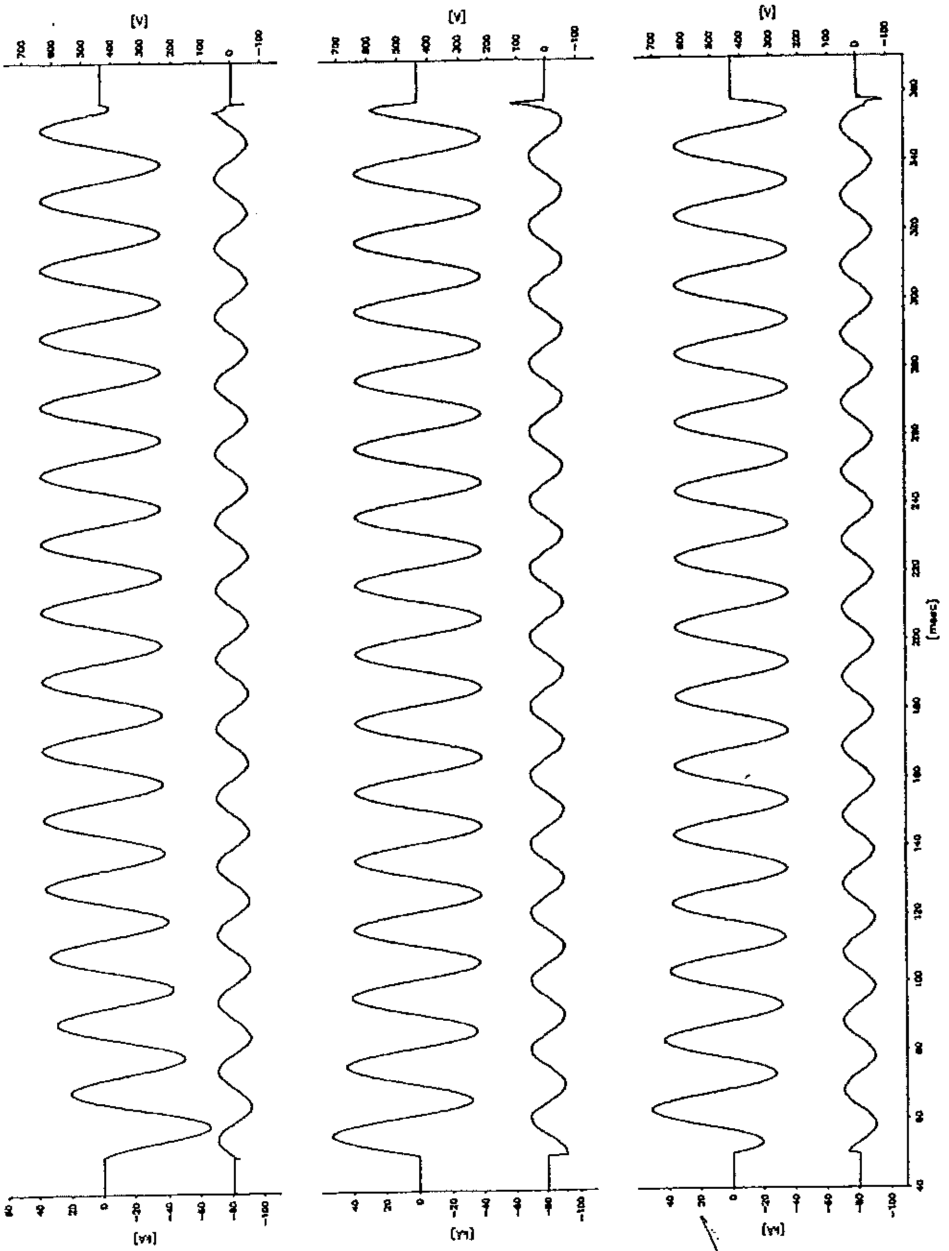
ВЯРНО С ОРИГИНАЛА



4.2.2002

HZ235F01.002

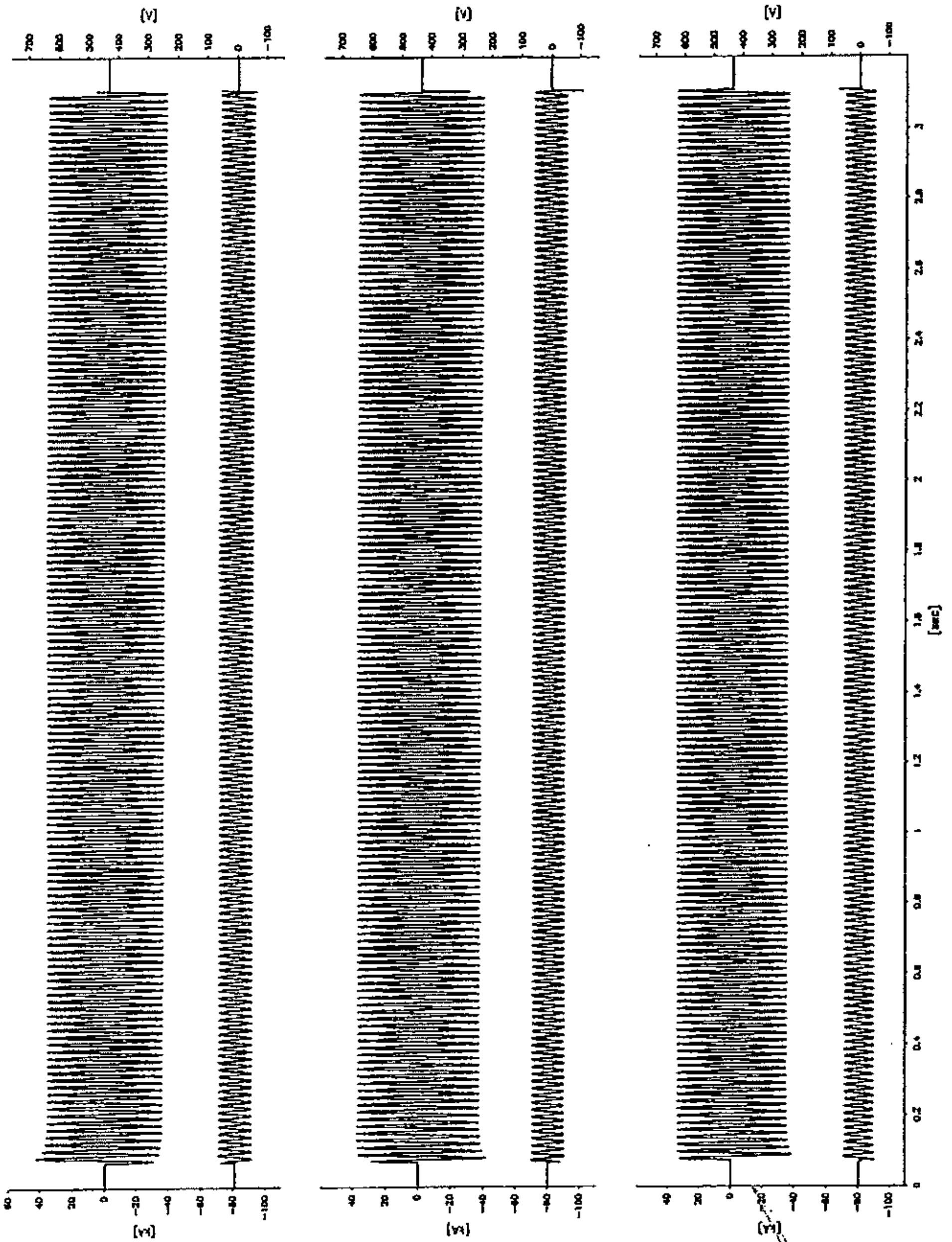
ВЯРНО С ОРИГИНАЛА



HZ235F01.004

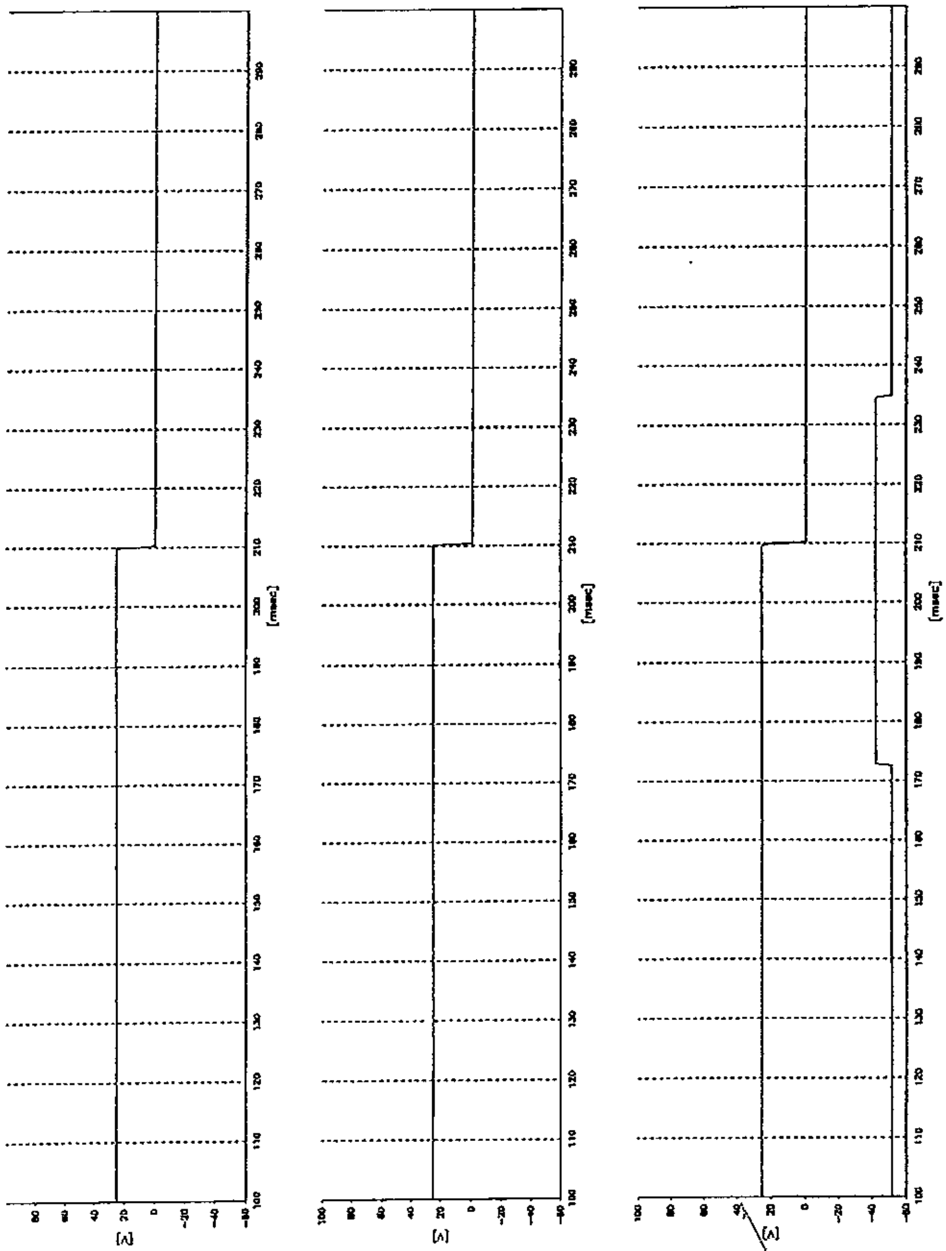
14.9.2000

ВЯРНО С ОРИГИНАЛА



HZ235F01.005

14.9.2000



HZ235F01.006

14.9.2000

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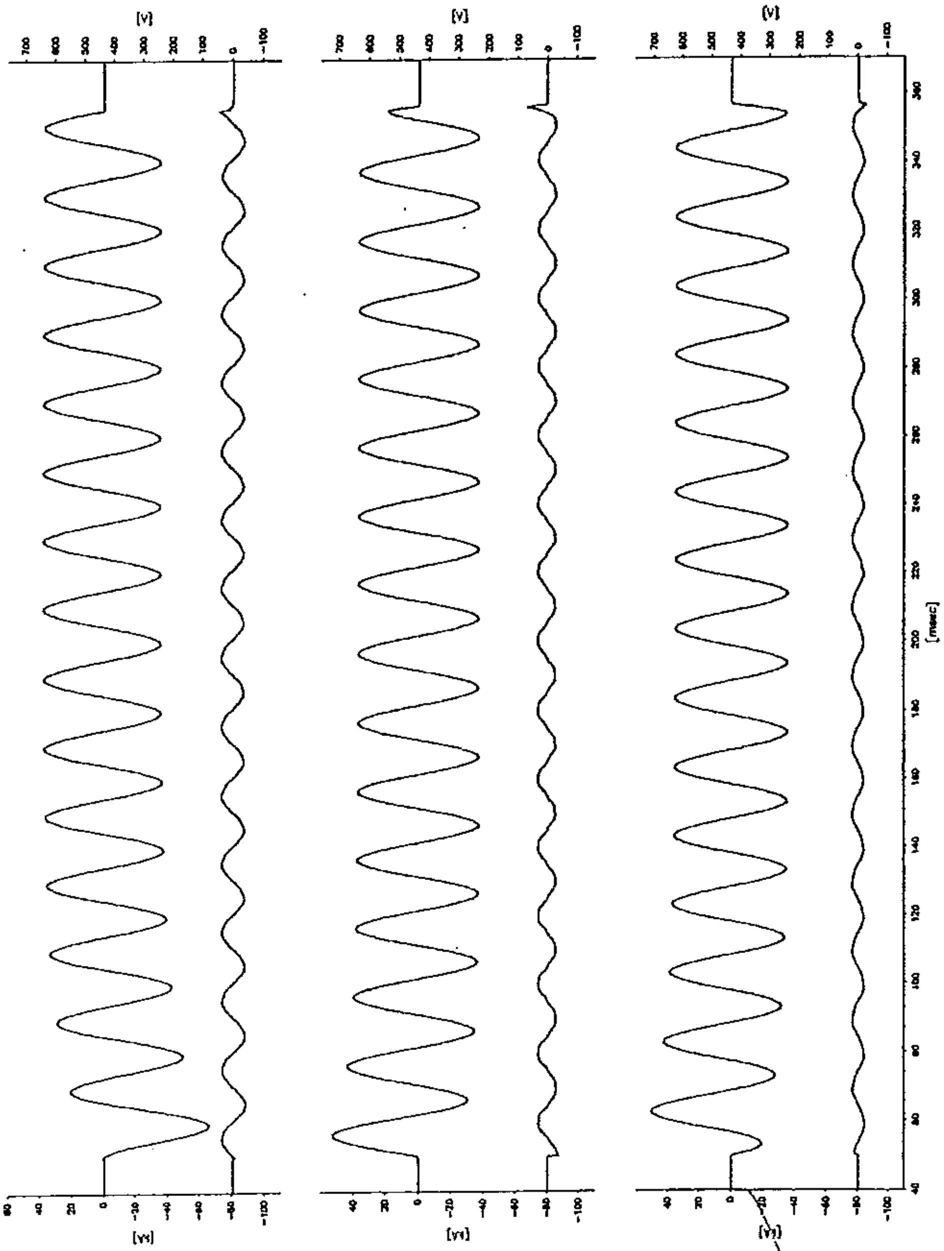
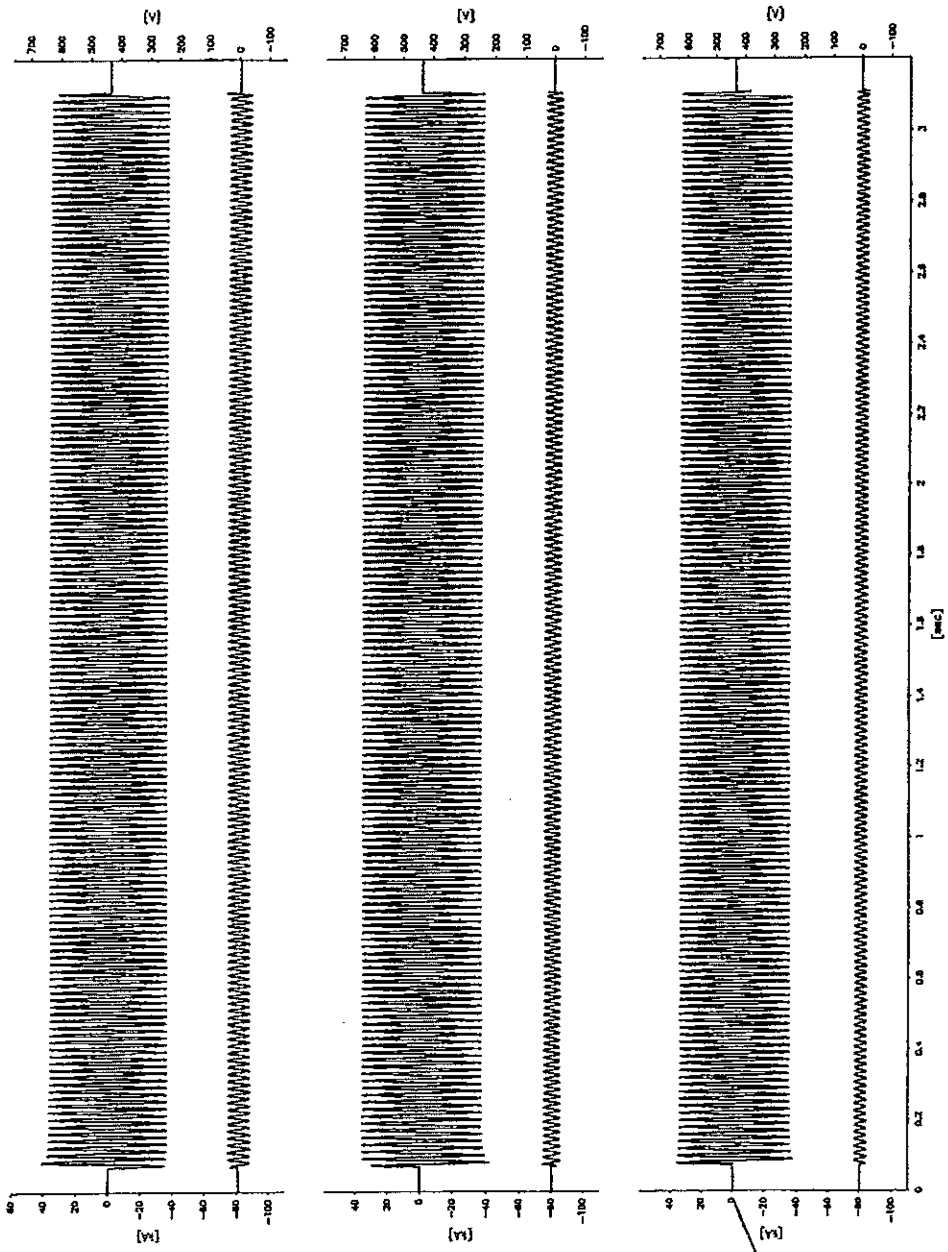


HZ235F01.008

14.9.2000



14.9.2000

HZ235F01.009

ВЯРНО С ОРИГИНАЛА

3

Deutscher Akkreditierungs Rat

DAR

Reg. No.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 235 L 02

Sheet 1

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 1

Test Object

Three-panel arrangement of metal-clad, air insulated switchgear type ZS1.2 (1000 mm, 1000 mm, 800 mm width) equipped with bushing plates

Rated voltage	U_r	24	kV
Rated normal current	I_r	1600/1600/1000	A
Rated frequency	f_r	50/60	Hz
Rated short-time withstand current	I_k	25	kA
Rated peak withstand current	I_p	63	kA
Rated duration of short-circuit current	t_k	3	s

Manufacturer

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33,
40472 Ratingen, Deutschland

Tests performed

Testing of the behaviour of the metal-clad switchgear under conditions of arcing due to internal faults with 25 kA - 1.0 s in different compartments of the three panels. For further details see sheet-no. 2 to 5.

Test Specification

The test has been carried out in accordance with the client's instructions. Test procedure and test parameters were based on IEC 60298/3rd Ed/1990-12, Clause 6.108, Annex AA in conjunction with PEHLA-Recommendation No. 4 / 3.1995.
(Accessibility Type A: Metal-enclosed switchgear and controlgear with accessibility restricted to authorized personnel only).

Test Results

The assessment of the test was carried out in accordance with criteria 1 to 6 of the above mentioned test specifications.
For further details see sheet-no. 2 to 5 and 16 to 20.

Test Date

12th and 14th December 2000

Client

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33,
40472 Ratingen, Deutschland

19th February 2002
Date of Issue

Dr. S. Göttlich
Laboratory Manager

A. Brandt
Andreas Brandt
Test Engineer

Total Number of Sheets: 30 Sheets **11 Oszillograms**

ВЯРНО С ОРИ

Comments on Test Arrangement and on the Test

The test object was a three-panel arrangement of a metal-clad, air insulated switchgear type ZS1.2 for 24 kV, consisting of a 1000 mm width outgoing panel left-handed, of a 1000 mm width incoming panel in centre and a 800 mm width outgoing panel right-handed. The switchgear was installed in a room mock up with a ceiling height of approximately 3 m. The distance between the rear wall of the switchgear and the room mock up was approximately 0.2 m. The pressure relief took place by a top mounted pressure relief duct overcoming 1800 mm at the side wall of the left-handed panel.

Each panel was equipped with a VD4 vacuum circuit-breaker dummy and a common earthing bar of copper 30 x 8 mm^2.

Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

For all tests black cretonne indicators (cotton fabric approximately 150 g/m^2) were placed in front of and on one side of the switchgear as stated in the relevant test regulations.

During the tests the pressure gauge in the compartment under test was measured and recorded. The tests were filmed with a high-speed video camera with a frequency of 500 frames/s.

The evaluation of the RMS-value of the short-circuit current was made according to the Simpson-Formula.

ВЯРНО С ОРИГИНАЛА

Test Results

Test-no.: HZ 235 L 02 / 03 Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Peak short-circuit current:	59.7 kA
Short-circuit current:	24.7 kA - 1.03 s equivalent to 25.0 kA - 1.02 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 235 L 02 / 04 Internal arcing test in the cable compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Peak short-circuit current:	59.7 kA
Short-circuit current:	24.9 kA - 1.04 s equivalent to 25.0 kA - 1.03 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test Results

Test-no.: HZ 235 L 02 / 05 Internal arcing test in the circuit-breaker compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Peak short-circuit current:	58.8 kA
Short-circuit current:	24.7 kA - 1.04 s equivalent to 25.0 kA - 1.02 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 235 L 02 / 06 Internal arcing test in the busbar compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the busbars.

Peak short-circuit current:	56.8 kA
Short-circuit current:	24.7 kA - 1.04 s equivalent to 25.0 kA - 1.03 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Test Results

Test-no.: HZ 235 L 02 / 07 Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the upper contact arms of the circuit-breaker.

Peak short-circuit current: 59.6 kA
Short-circuit current: 24.7 kA - 1.04 s equivalent to 25.0 kA - 1.03 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

Assessment of the Test

Extraction of IEC 60298/3rd Ed/1990-12, Annex AA

The following criteria allow for the arcing effects.
It is to be observed:

Criterion No. 1

Whether correctly secured doors, covers, etc., do not open.

Criterion No. 2

Whether parts (of the metal-enclosed switchgear and controlgear), which may cause a hazard, do not fly off. This includes large parts or those with sharp edges, for example, inspection windows, pressure relief flaps, cover plates, etc.

Criterion No. 3

Whether arcing does not cause holes to develop in the freely accessible parts of the enclosure as a result of burning or other effects.

Criterion No. 4

Whether the indicators arranged vertically do not ignite. Indicators ignited as a result of paint or stickers burning are excluded from this assessment.

Criterion No. 5

Whether the indicators arranged horizontally do not ignite. Should they start to burn during the test, the assessment criterion may be regarded as having been met, if proof is established of the fact that the ignition was caused by glowing particles rather than hot gases. Pictures taken by high-speed cameras should be produced in evidence.

Criterion No. 6

Whether all earthing connections are still effective.

Remark:

When the PEHLA-Recommendation No. 4 is stated under *Test Specification* in the Test Report the results of each test were assessed by all six criteria.

ВЯРНО С ОРИГИНАЛА

Participants of the Tests

Client:	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Representatives of the client:

Mr. Aufermann	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Mr. Groll	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA

Representatives of the laboratory:

Mr. Dr. Göttlich	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL

Test Engineer:

Mr. Brandt	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (left-handed and centre)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 1000 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2027/00
7550027/2025/00

Year of manufacture: 2000

Drawing Nos.: See sheet-no. 10

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1600	A
Rated short-circuit peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated
- tee-off bars 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated

Date of receipt of test object: 11th December 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (right-handed)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 800 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2022/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 10

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1000	A
Rated short-circuit peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, insulated
- tee-off bars 1 x 60 mm x 10 mm / R 5 mm, Cu, insulated

Date of receipt of test object: 11th December 2000

ВЯРНО С ОРИГИНАЛА

Table of Drawings of Test Objects

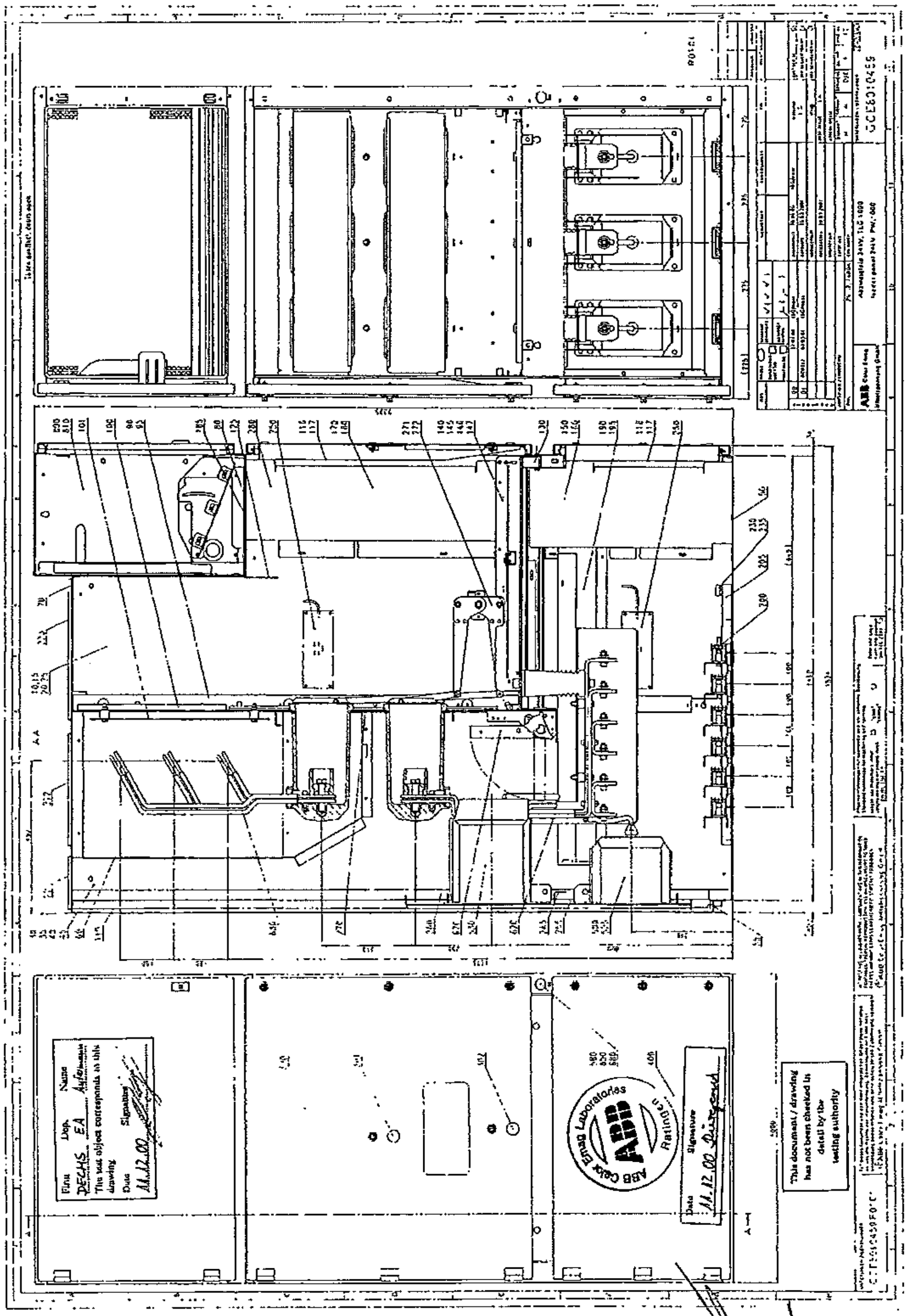
The drawings submitted for identification of the test object were stamped and signed by the test engineer.

The manufacturer/client has guaranteed by signature on the drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

A copy of the following drawing is part of this Test Report:

ZS 1.2, feeder panel 24 kV, PW.1000	GCE8010459R0101,	sheet 1, index 01,
ZS 1.2, feeder panel 24 kV, PW.800	GCE8010457R0101,	sheet 1, index 01,
Type Test Arrangement (internal fault) ZS1.2 – Panel 24kV	GCEP800240	sheet 1, index 00

ВЯРНО С ОРИГИНАЛА

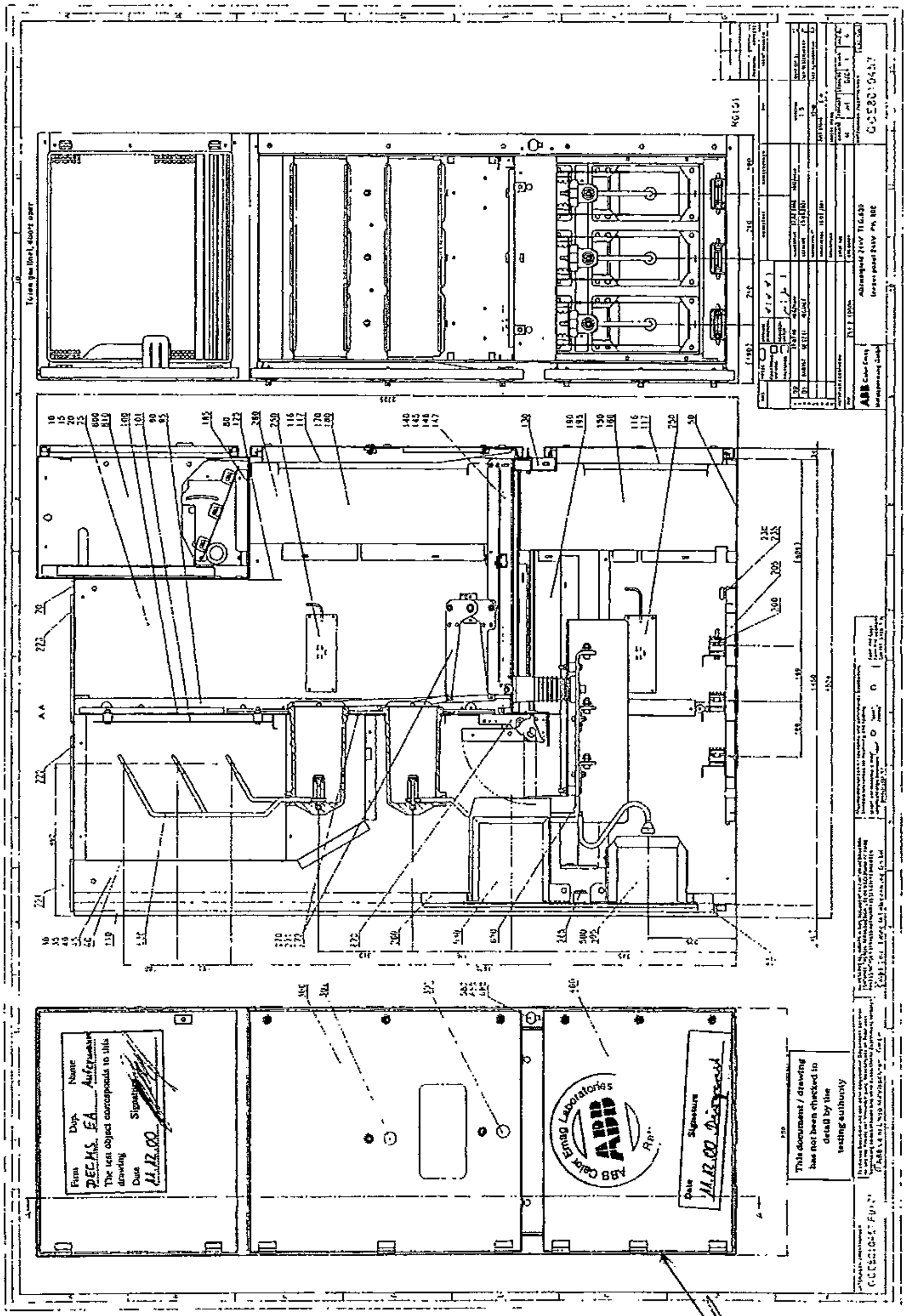


Firma DECHS Dep. EA Name Aufermann
This test object corresponds to this drawing
Date 11.12.00 Signature

ABB Calor Emag Laboratories Ratingen
Date 11.12.00 Signature

This document / drawing has not been checked in detail by the testing authority

ВЯРНО С ОРИГИНАЛА



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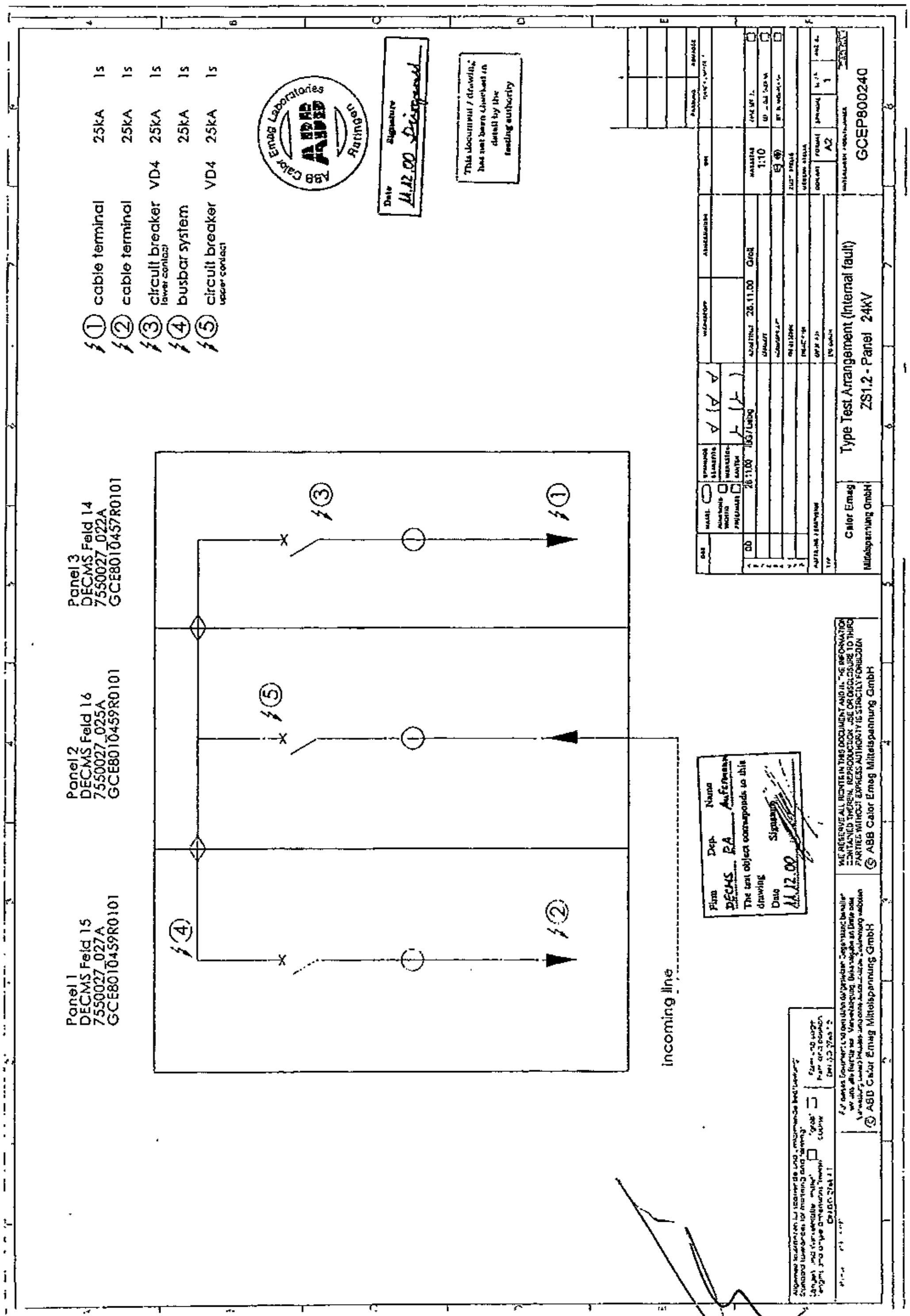

ABB Calor Emag Laboratories Ratingen

Date 11.12.00 Signature

This document / drawing has not been checked in detail by the testing authority

Firm DECMS Dep. PA Name Aufermann
The test object corresponds to this drawing
Date 11.12.00 Signature

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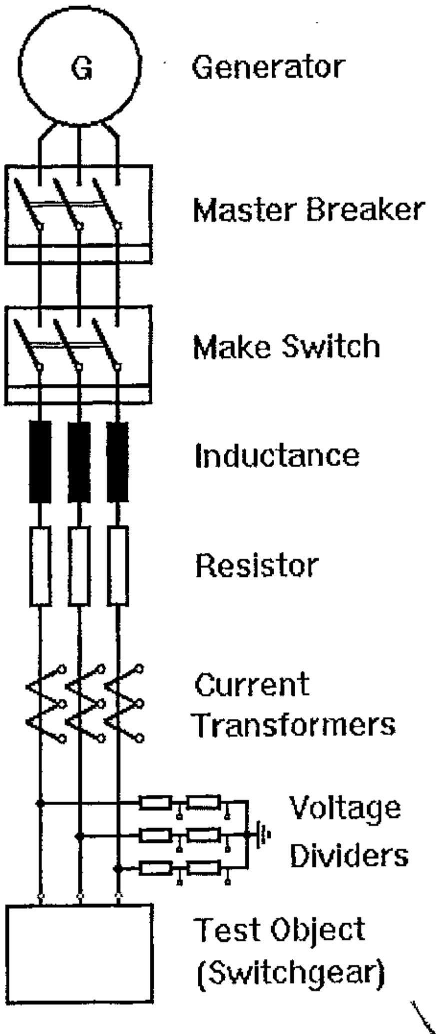
ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuit

Test	Internal fault	-	-	-
Oscillogram-No. HZ 235 L 02	02 - 07	-	-	-
Number of phases (circuit)	3	-	-	-
Number of poles/phases (test object)	3	-	-	-
Power frequency Hz	50	-	-	-
Power factor cos φ	≤ 0.15	-	-	-
Earthing Generator	earthed via 5 kΩ	-	-	-
Earthing Transformer	not earthed	-	-	-
Earthing Short-circuit point	not earthed	-	-	-
Circuit diagram Sheet no.:	16	-	-	-
Circuit impedance mΩ	≈ 170	-	-	-
-	-	-	-	-
TRV control elements	-	-	-	-
Capacitance in parallel µF	-	-	-	-
Resistance in series Ω	-	-	-	-
-	-	-	-	-
-	-	-	-	-
Prospective TRV -	-	-	-	-
TRV peak value u_c kV	-	-	-	-
Time co-ordinate t_3 µs	-	-	-	-
Time delay t_d µs	-	-	-	-
Based on kV	-	-	-	-
Rate-of-rise kV/µs	-	-	-	-
-	-	-	-	-
-	-	-	-	-
Voltage measurements	Divider 375 kΩ / 2 kΩ	-	-	-
Current measurements	Transformer 50 kA / 5 A	-	-	-

Remarks:
HZ 235 L 02 / 01: Current calibration

Principle Diagram of Test Circuit



ВЯРНО С ОРИГИНАЛА

Determination of the Prospective Short-Circuit Current

Condition of test object before test: -

Arrangement: See sheet-no. 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

For the determination of the prospective short-circuit current the infeeding busbars of the test plant were short-circuited and earthed outside the switchgear under test.

Test-No.: HZ 235 L 02 / 02		Applied voltage (phase-to-phase) 7.30 kV		Duration of short-circuit current 1.03 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	65.8	27.2	25.8	25.0
L2	19.6	26.9	25.9	25.1
L3	51.3	26.9	25.5	24.8
	Average value	27.0	25.7	25.0
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks: -

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: Switchgear factory-new.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Test-No.: HZ 235 L 02 / 03		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.03 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	59.7	26.9	25.6	24.8
L2	18.3	26.3	25.7	24.9
L3	45.4	26.4	25.2	24.4
	Average value	26.5	25.5	24.7
Equivalent duration of short-circuit current 1.02 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 42 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 03.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the cable terminals.

Test-No.: HZ 235 L 02 / 04		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	59.7	27.1	25.8	25.1
L2	20.5	26.0	25.7	25.0
L3	47.5	26.6	25.4	24.6
	Average value	26.6	25.7	24.9
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 45 kPa.

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 04.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Test-No.: HZ 235 L 02 / 05		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	58.8	26.8	25.3	24.5
L2	19.4	26.3	25.7	24.8
L3	46.4	27.0	25.6	24.7
	Average value	26.7	25.5	24.7
Equivalent duration of short-circuit current 1.02 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 31 kPa.

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 05.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the busbar compartment of the left-handed panel (1000 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the busbars.

Test-No.: HZ 235 L 02 / 06		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	56.8	26.6	25.5	24.7
L2	19.3	25.3	26.5	25.0
L3	44.1	26.9	24.7	24.2
	Average value	26.3	25.6	24.7
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 60 kPa.

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 235 L 02 / 06.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 185 mm^2 through the closed bottom of the centre panel.

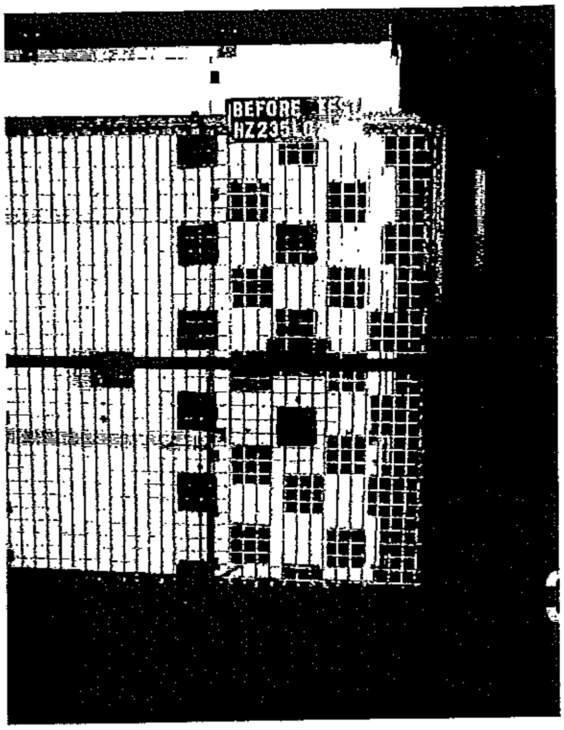
Ignition: Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the upper contact arms of the circuit-breaker.

Test-No.: HZ 235 L 02 / 07		Applied voltage (phase-to-phase) 7.45 kV		Duration of short-circuit current 1.04 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	59.6	26.7	25.2	24.6
L2	18.7	26.7	25.8	25.0
L3	45.9	27.0	25.3	24.7
	Average value	26.8	25.5	24.7
Equivalent duration of short-circuit current 1.03 s			**corresponding to a short-circuit current of** 25.0 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 23 to 29. The measured pressure gauge was about 28 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА



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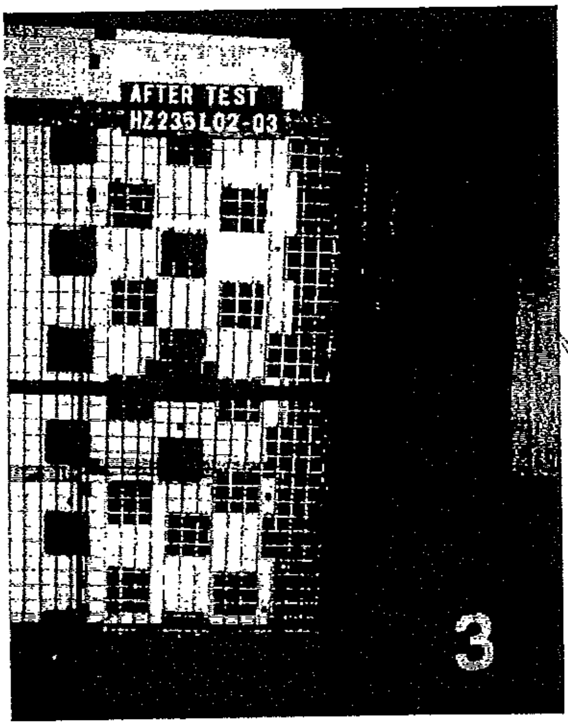

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After Test HZ 235 L 02 / 03

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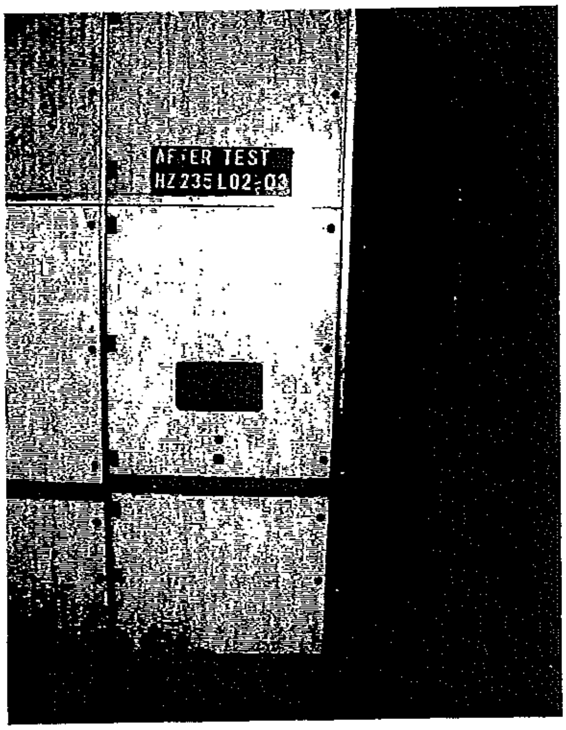

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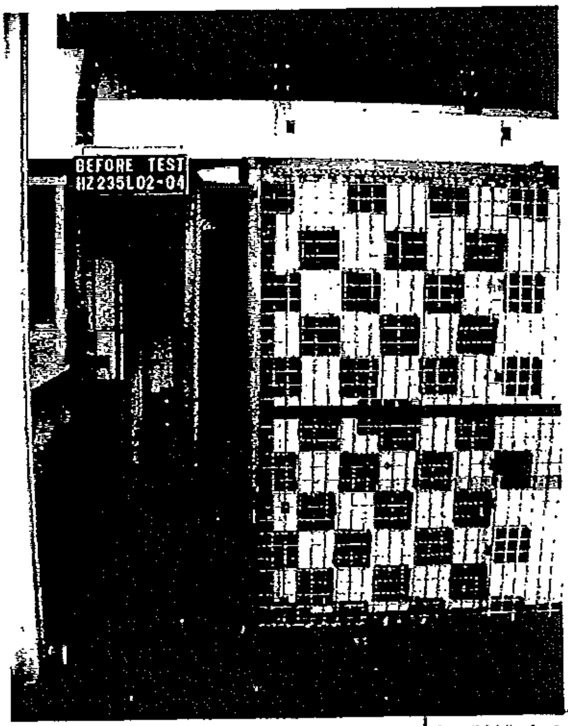

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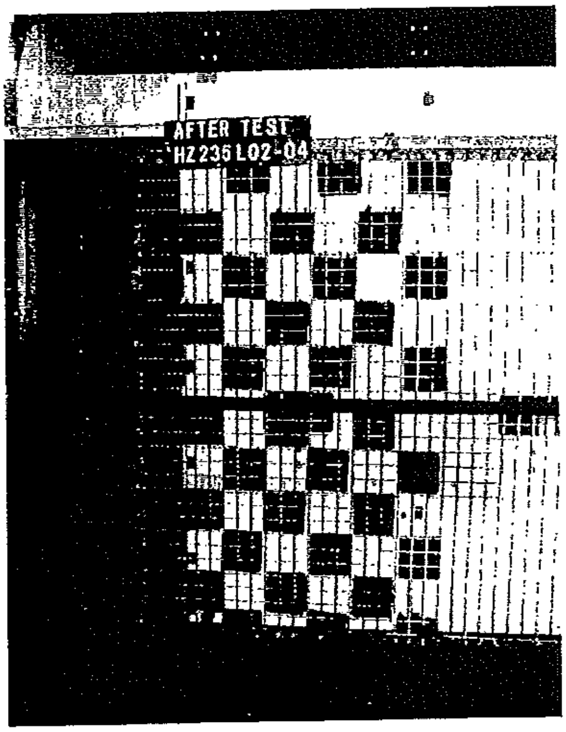

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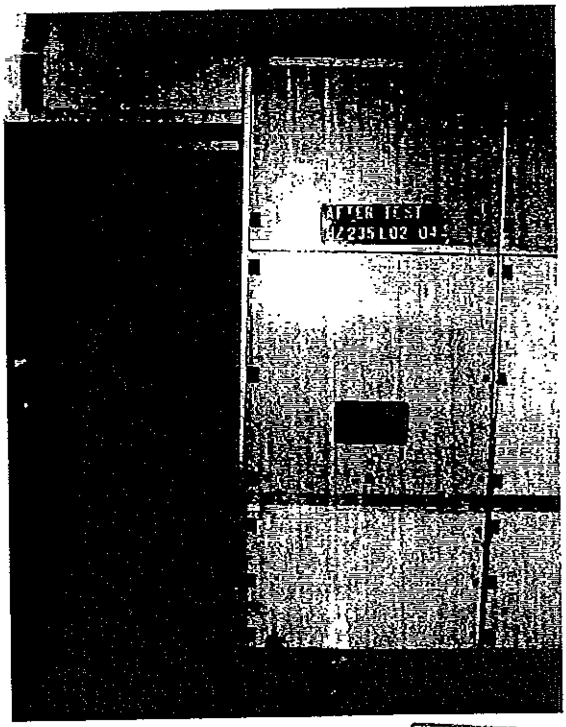

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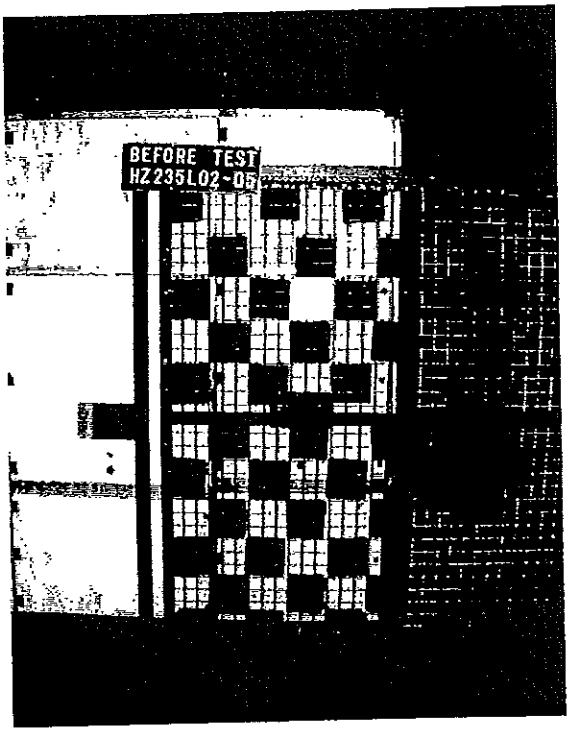

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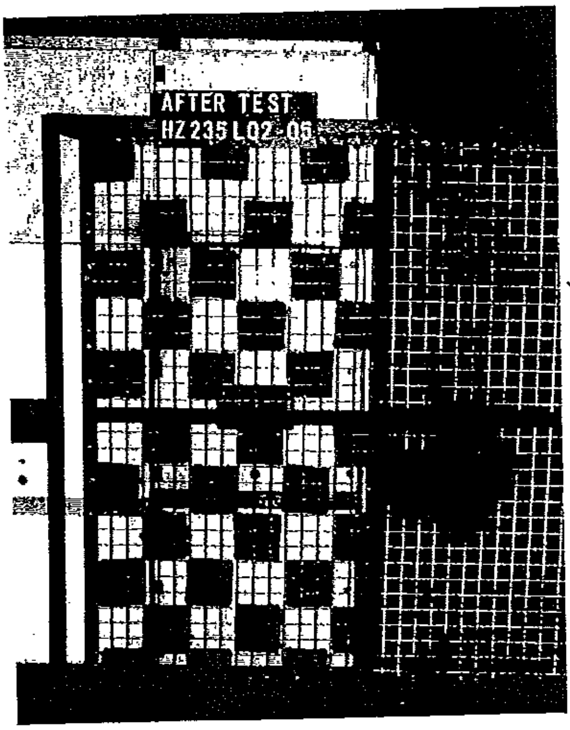

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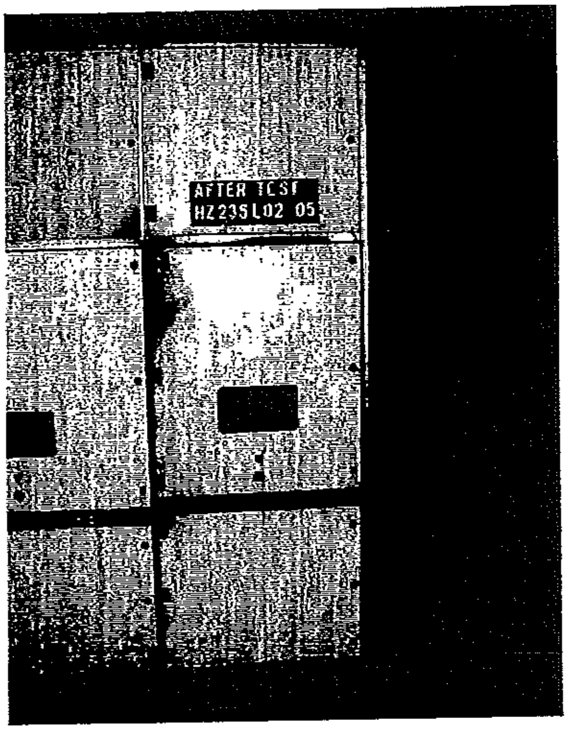

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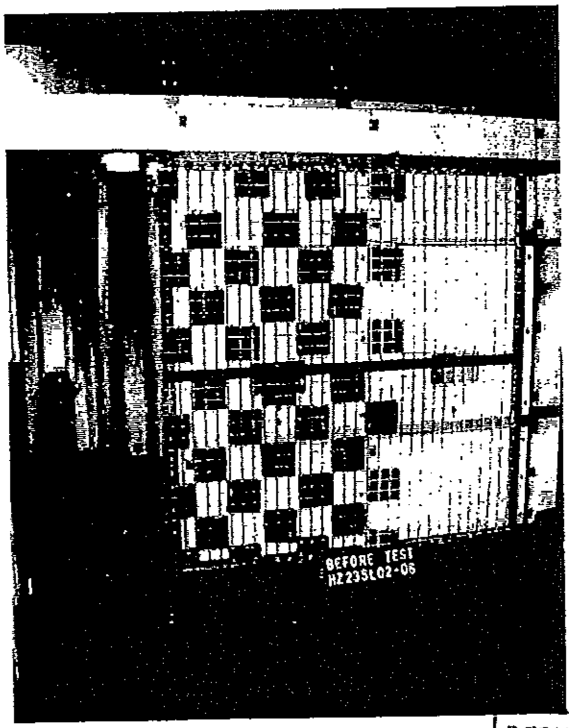

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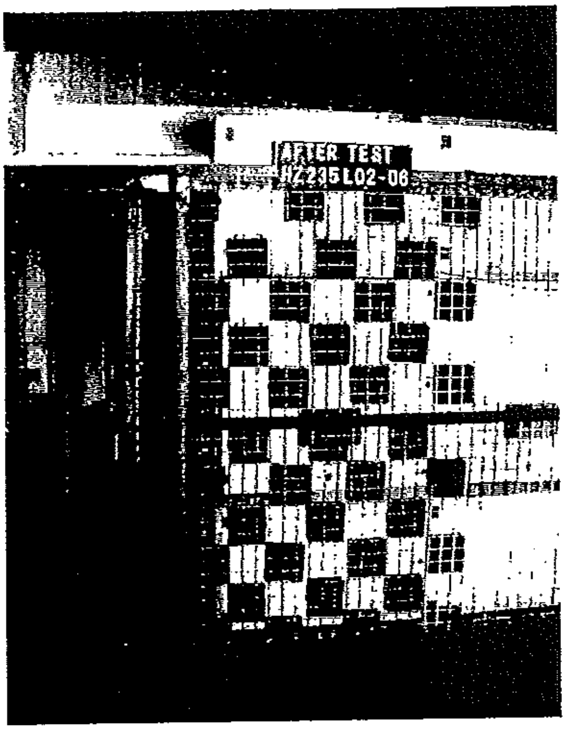

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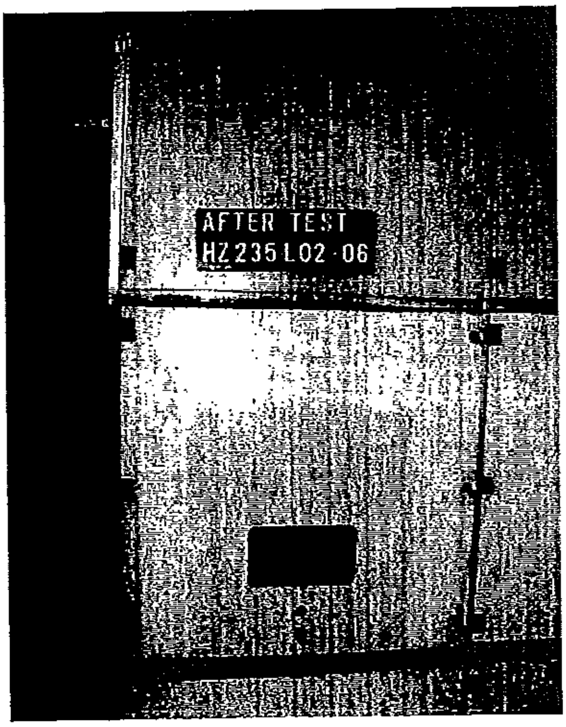

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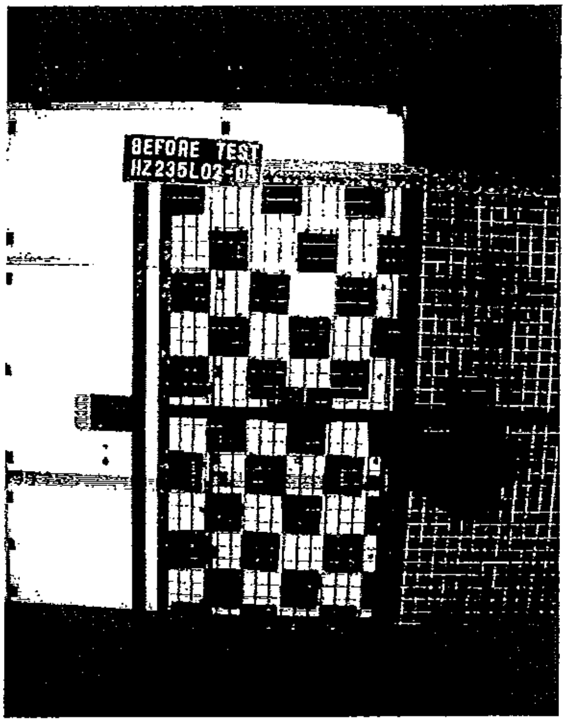

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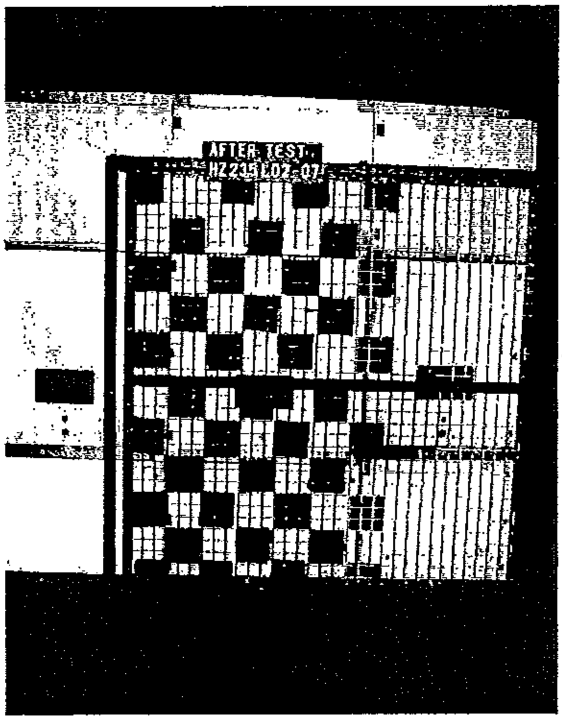

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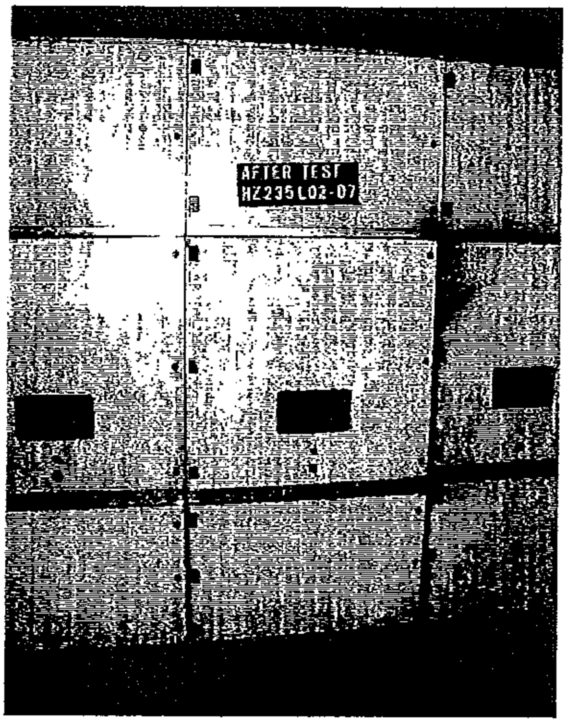

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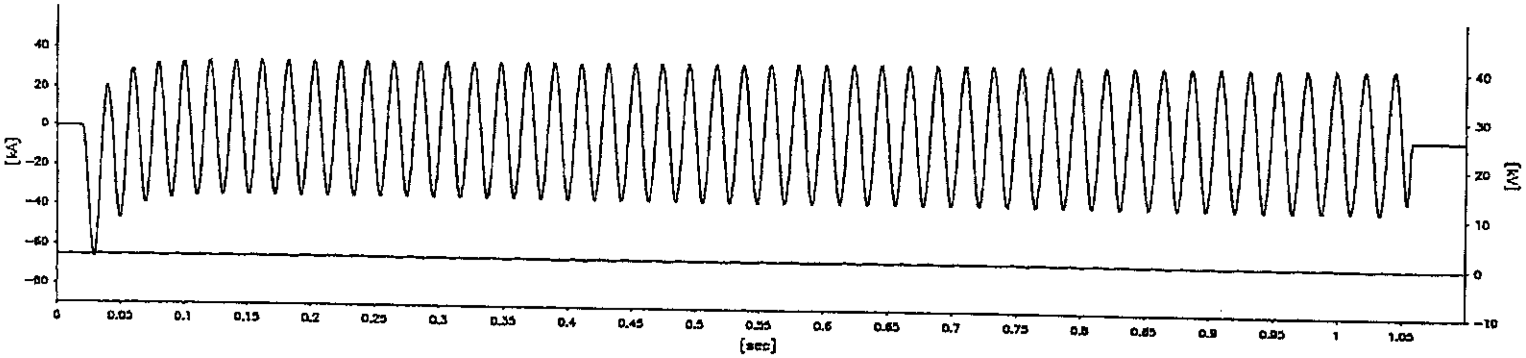

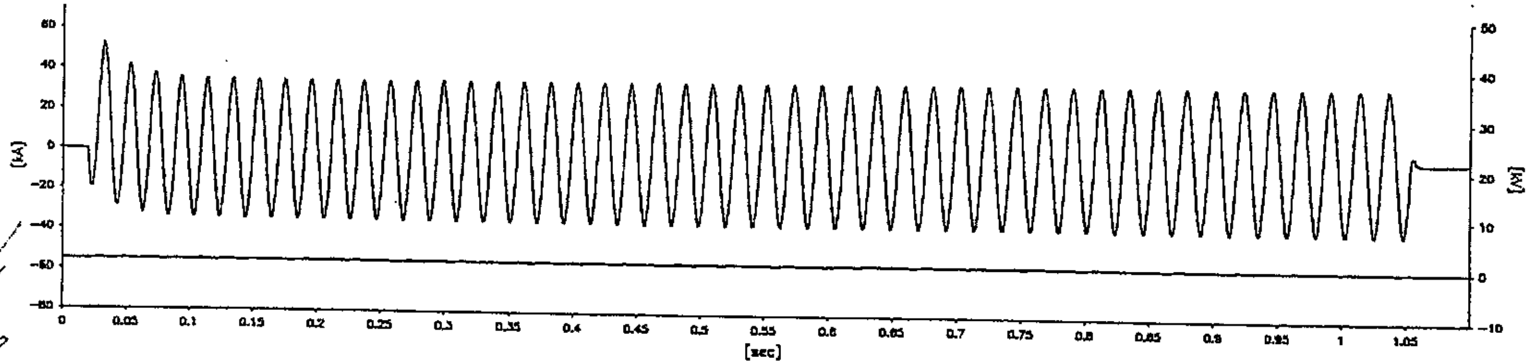

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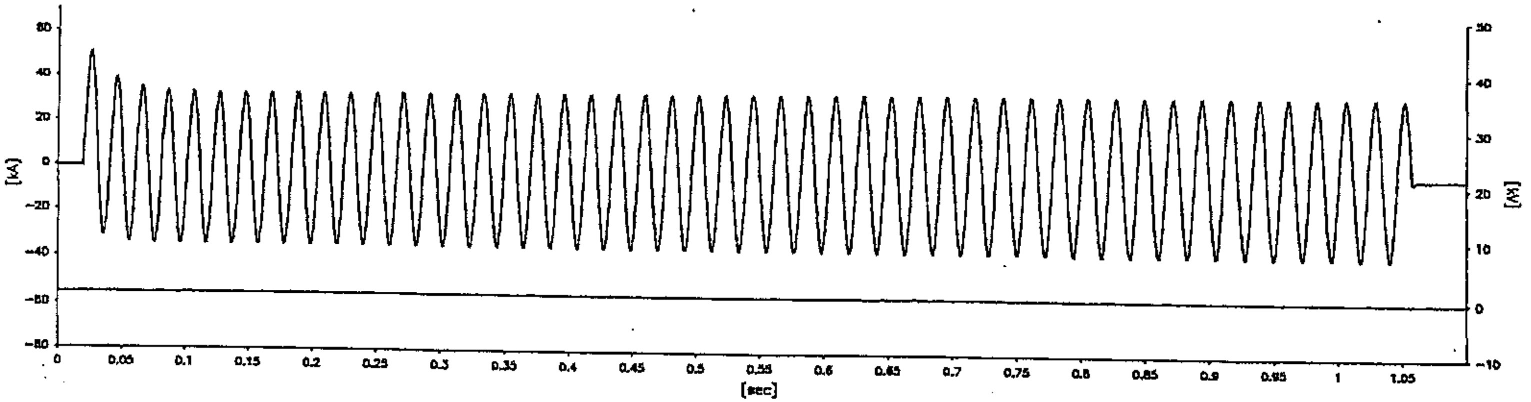

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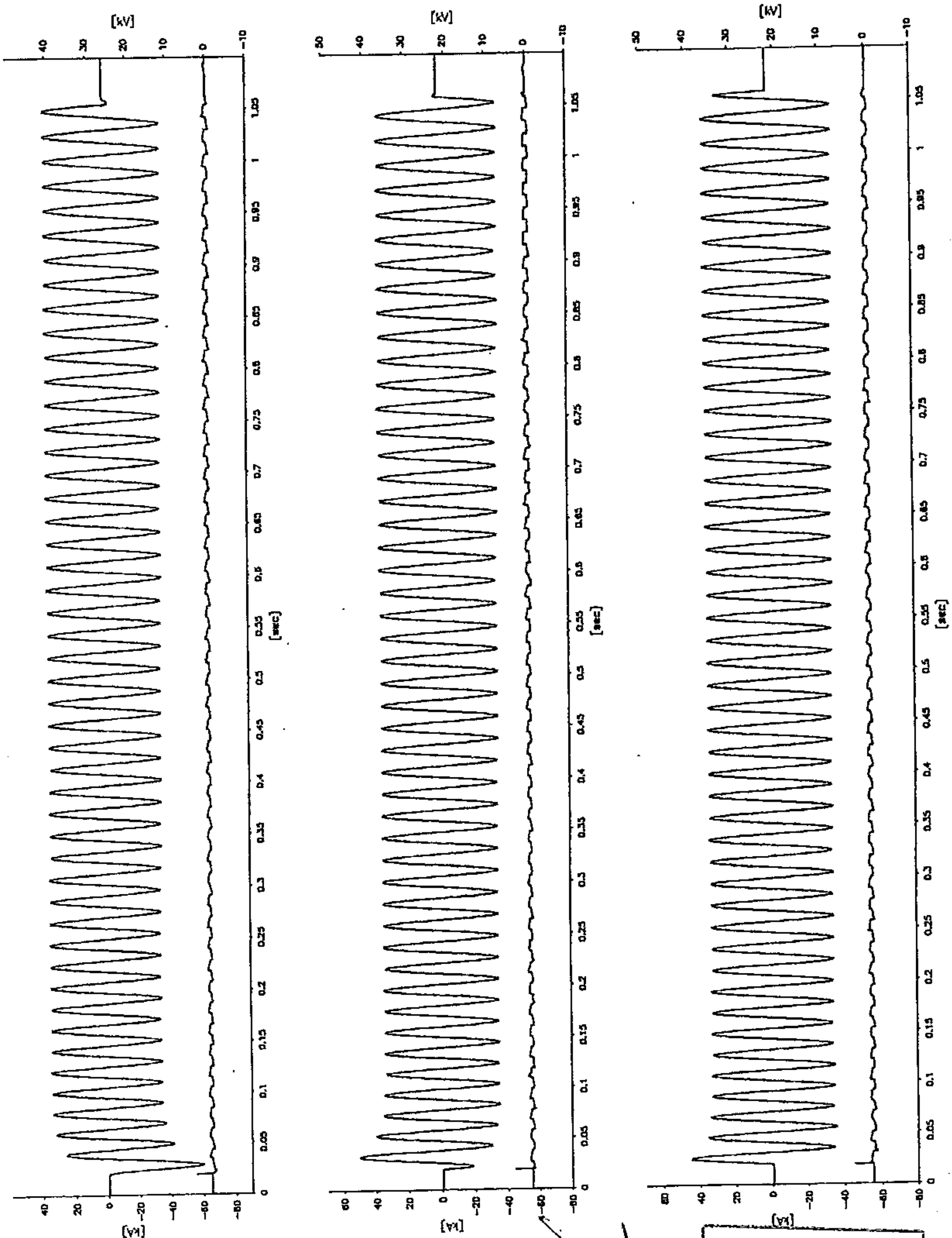

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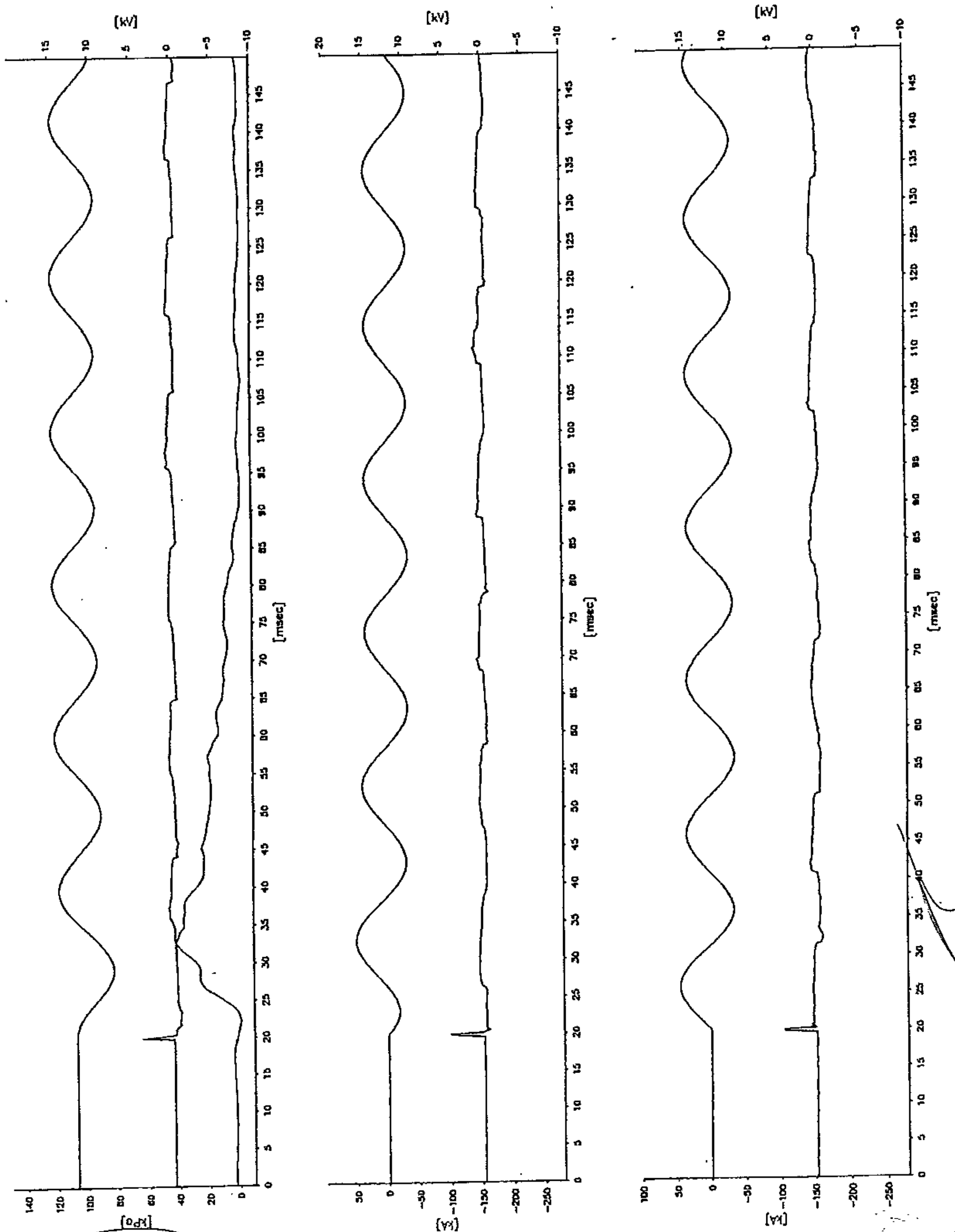

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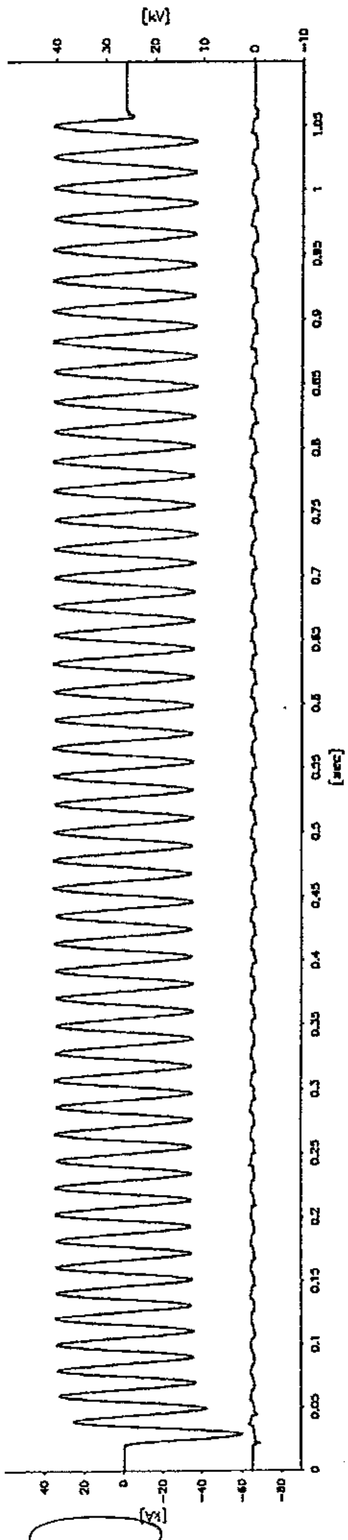

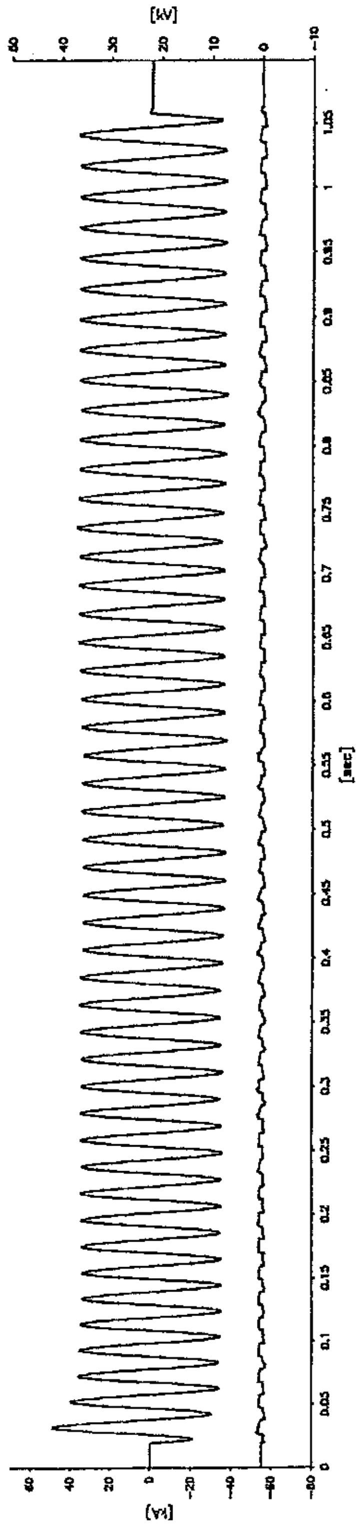

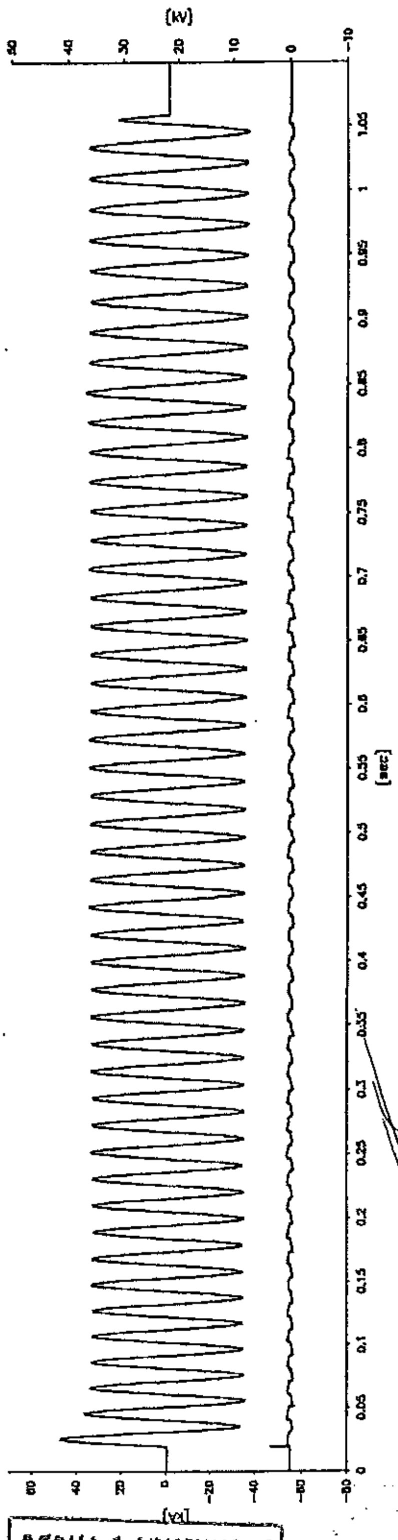

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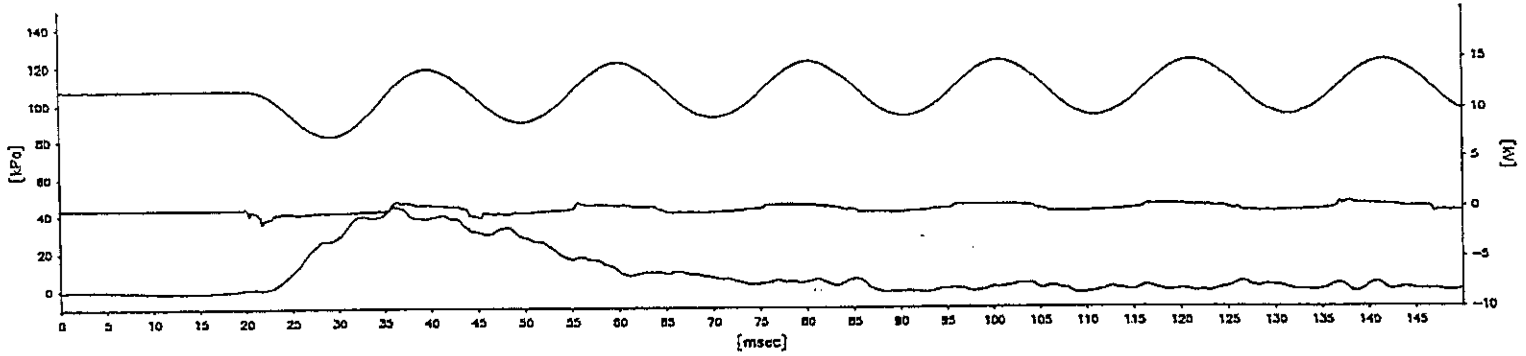

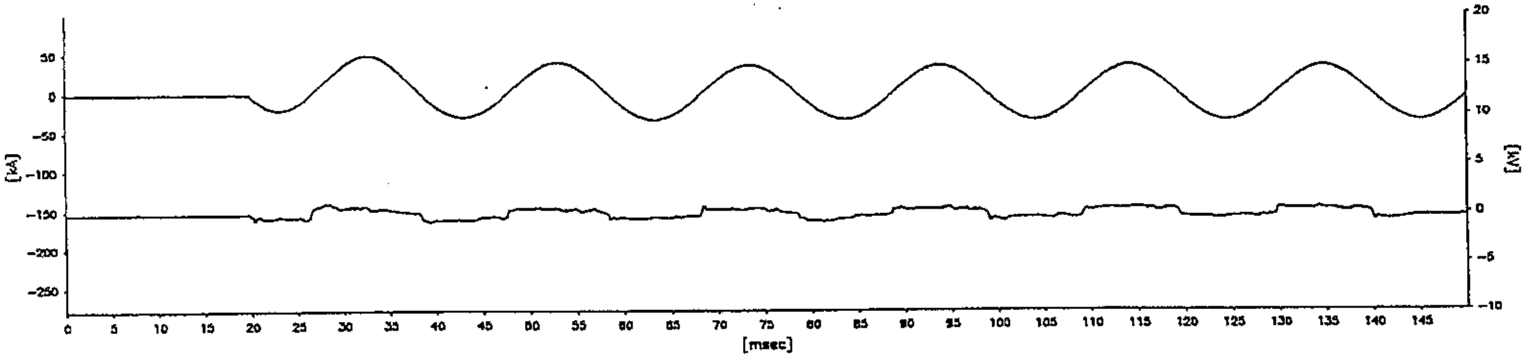

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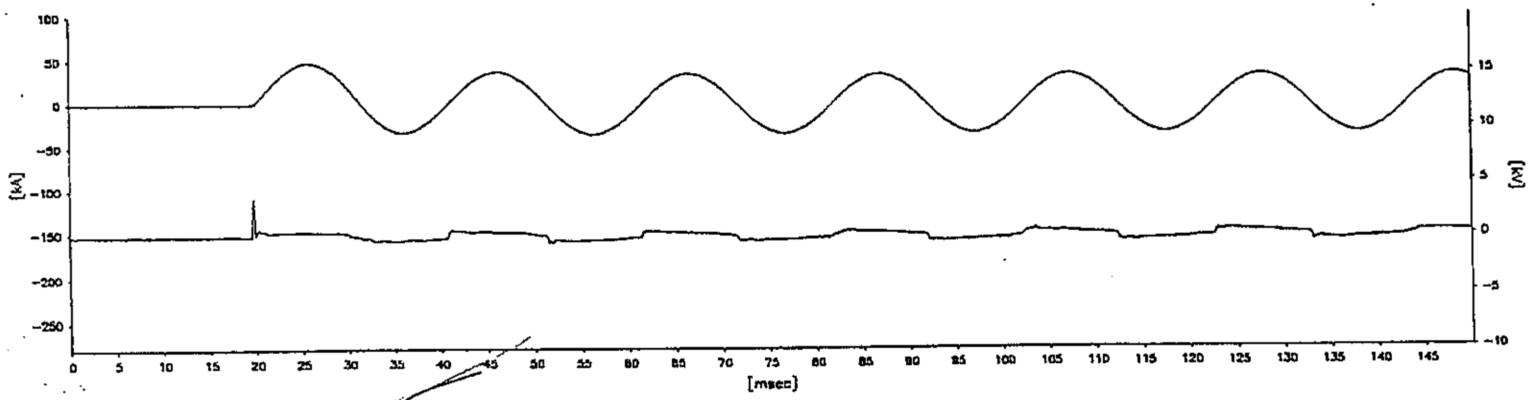

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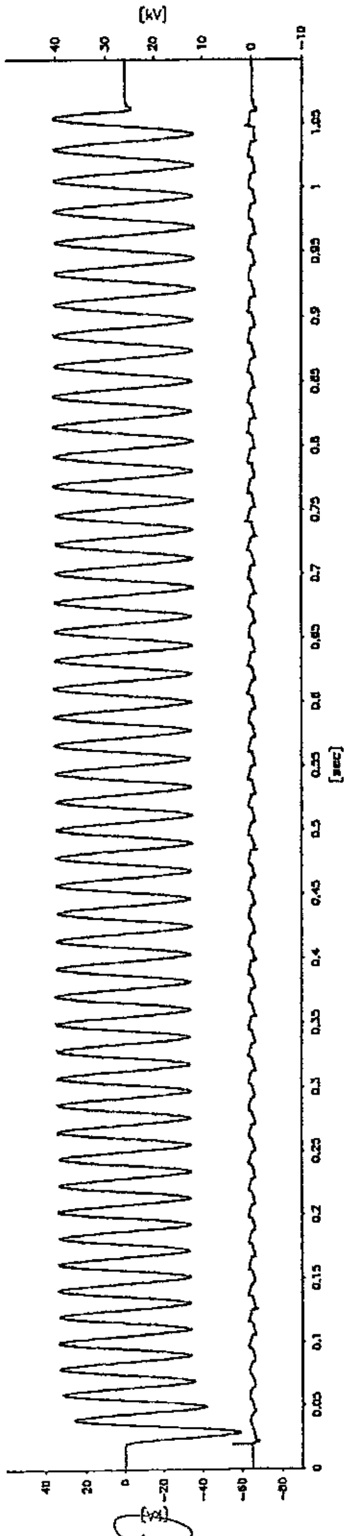

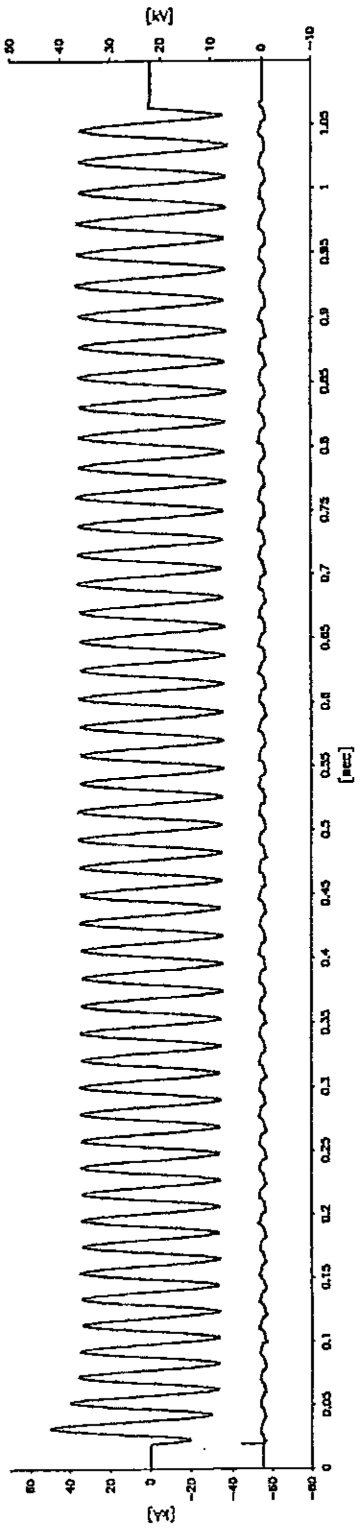

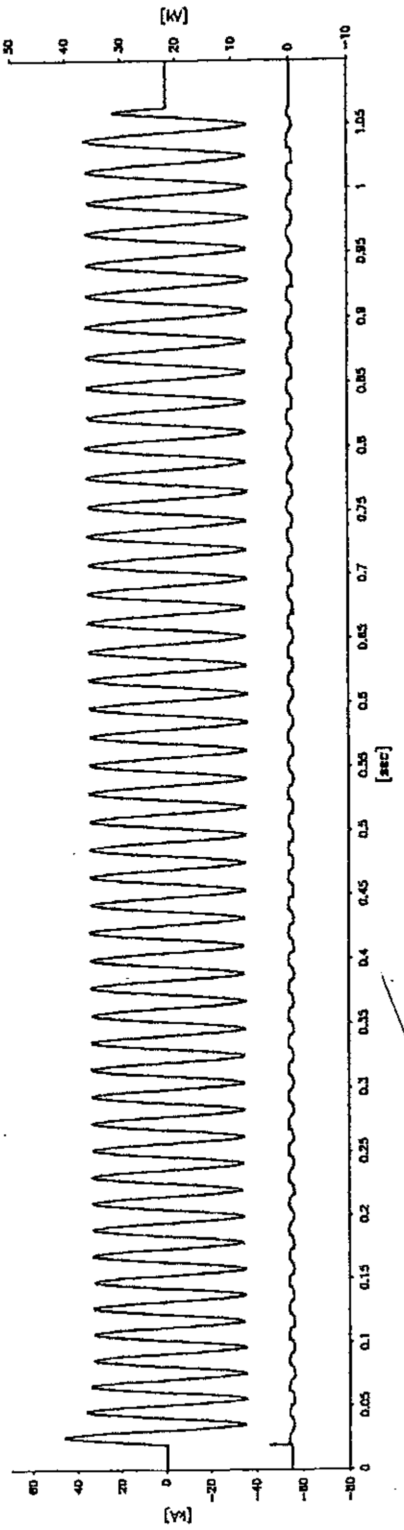

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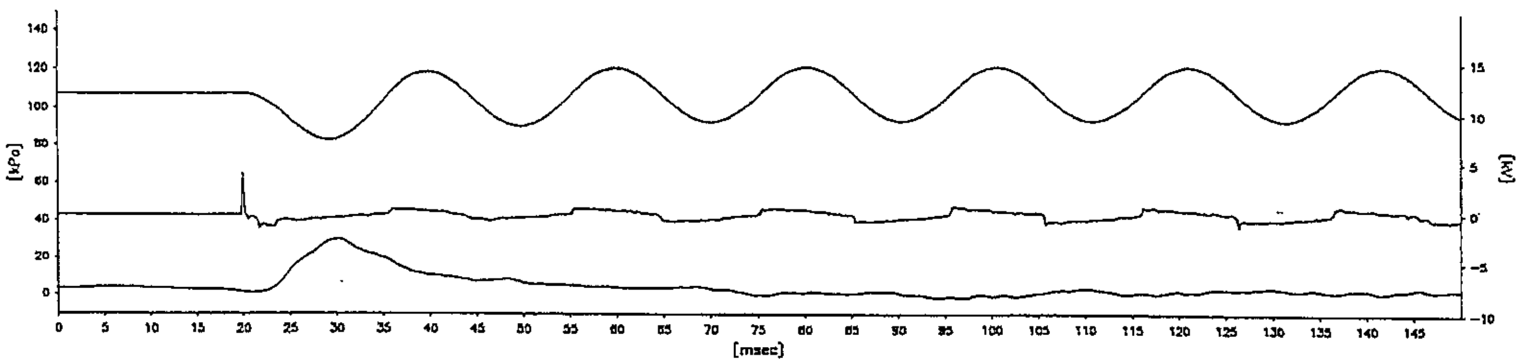

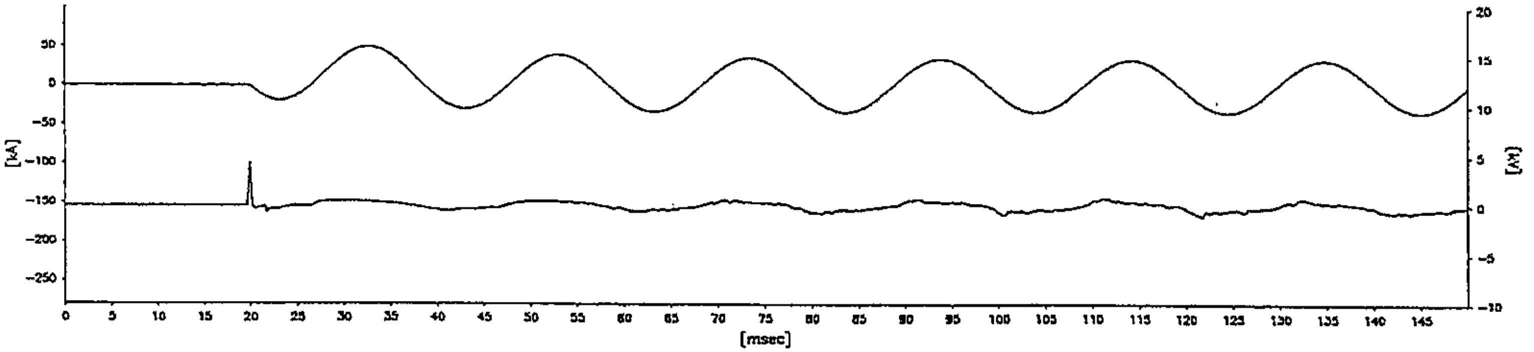

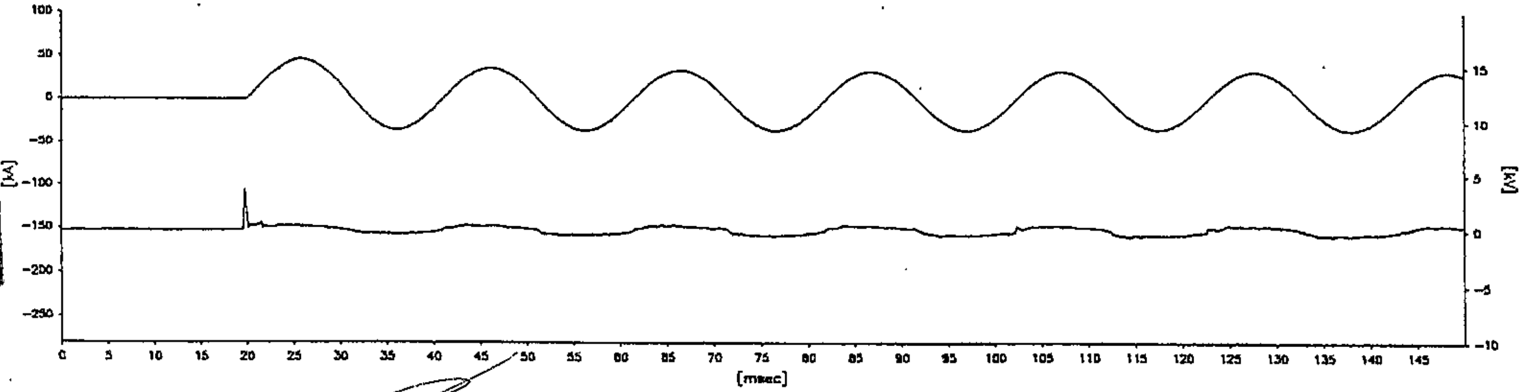

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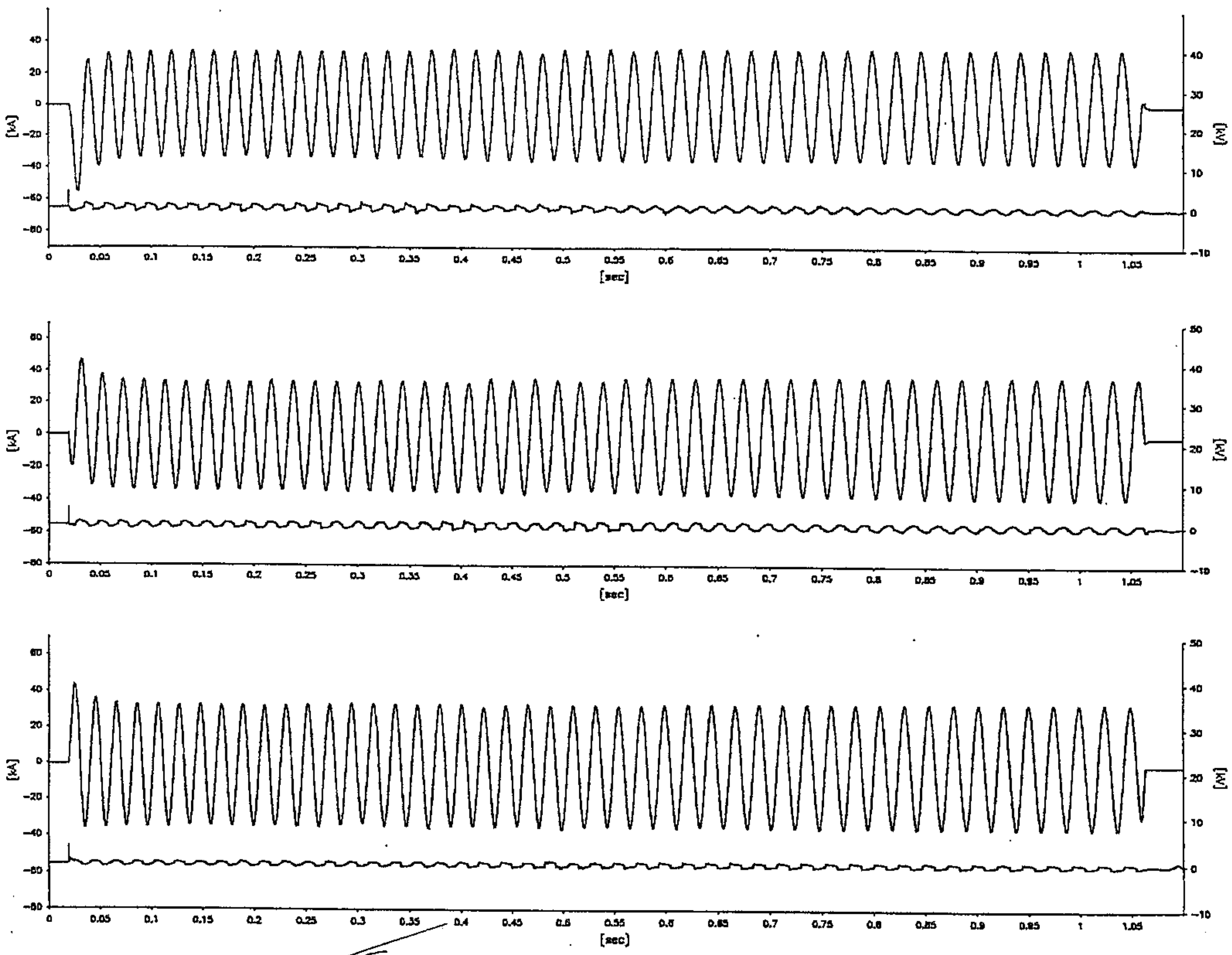

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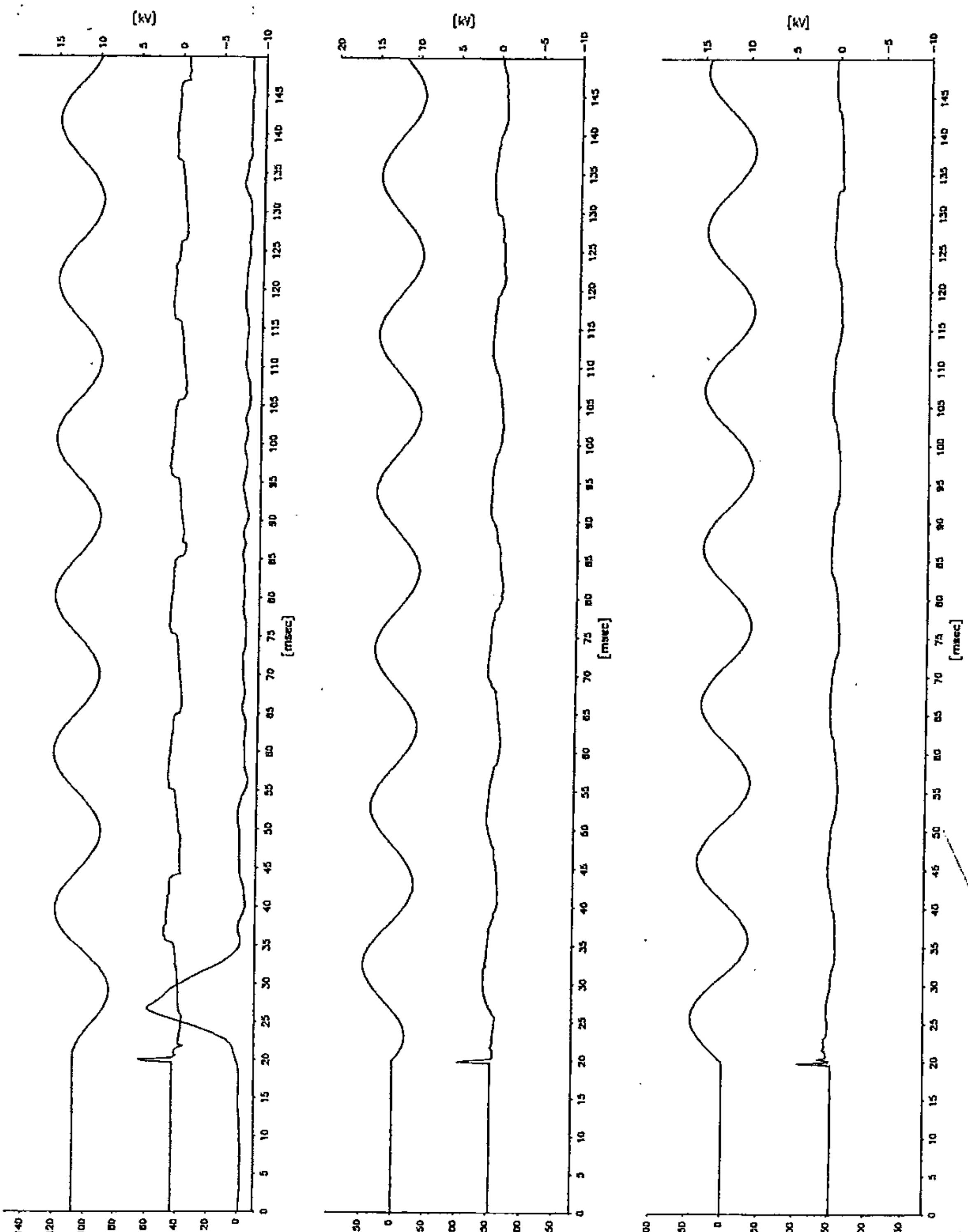

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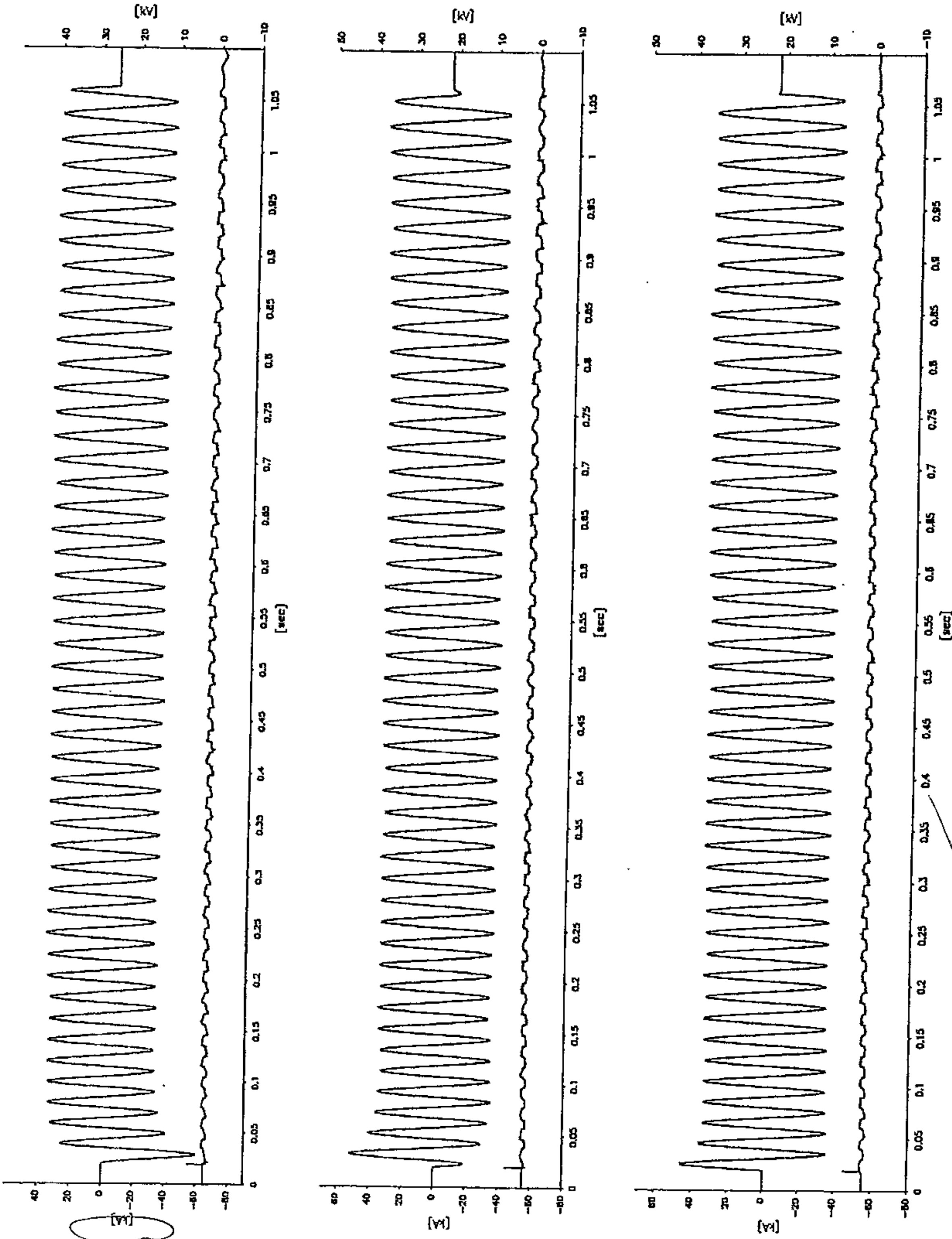

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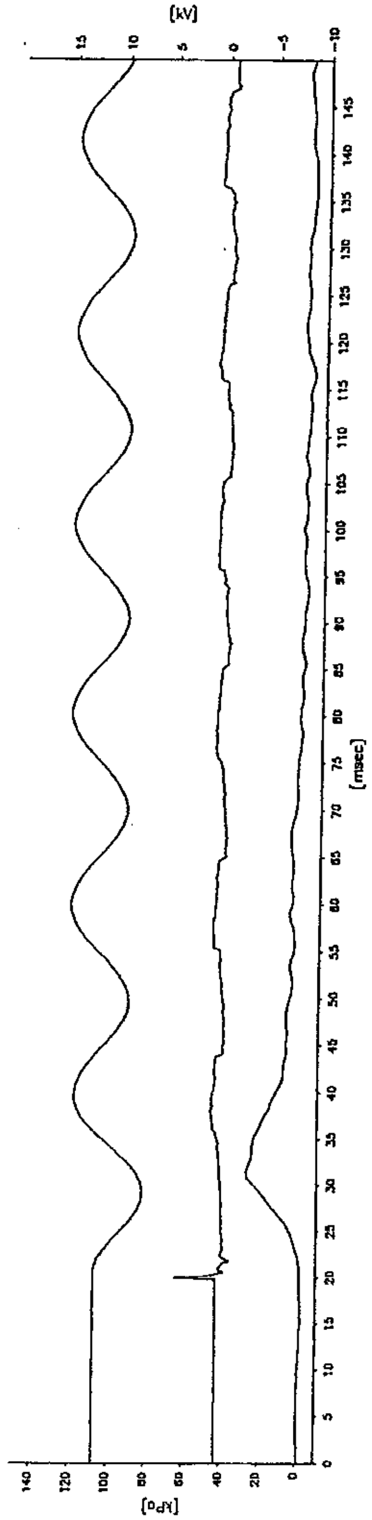

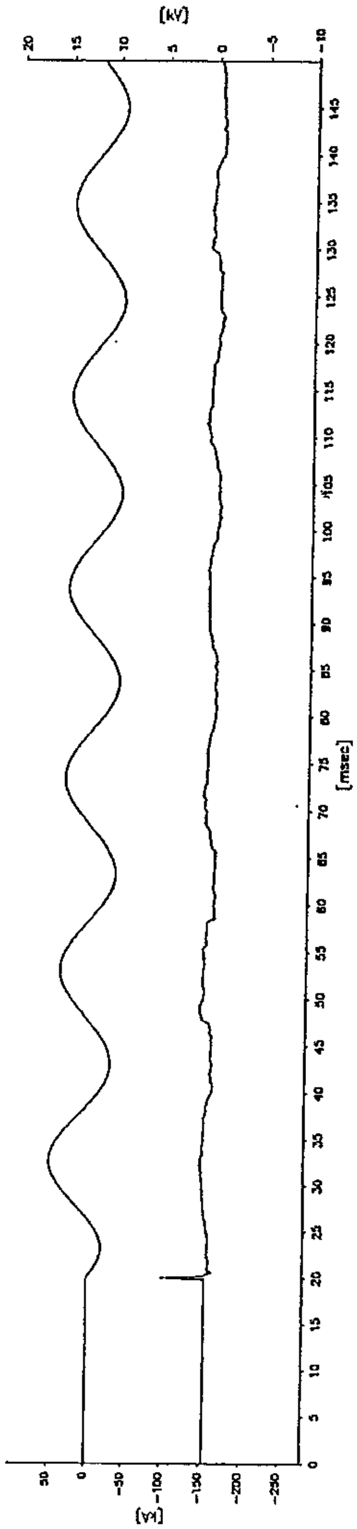

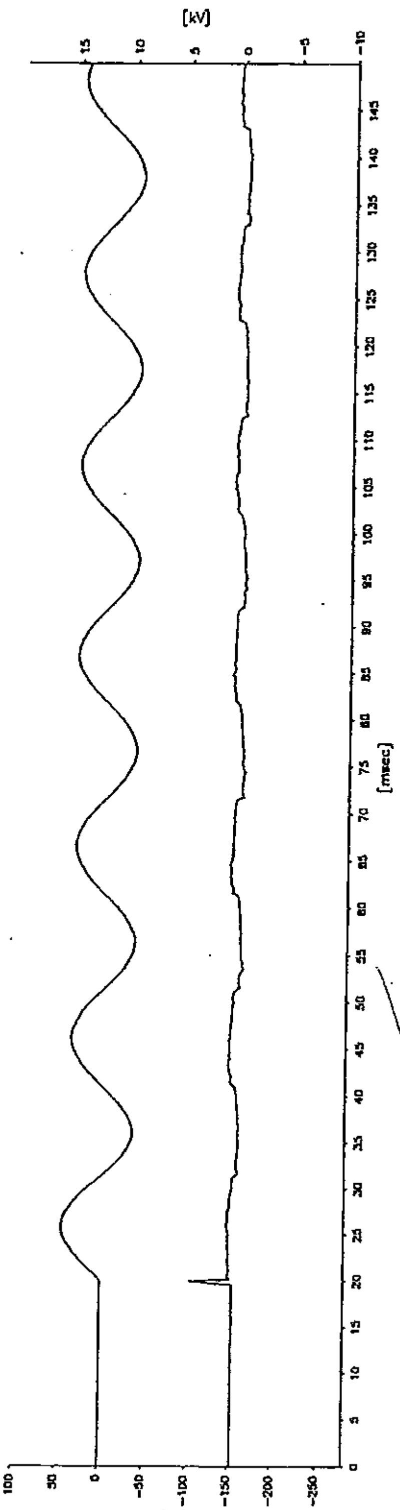

HZ235L02.007

12.12.2000

ВЯРНО С ОРИГИНАЛА

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Akkreditierungs
Rat
DAR

Reg.-Nr.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. MZ 235 A 01

Issued by an Accredited Laboratory
corresponding to EN 45001

Sheet 1

Copy-No. 02e

Test Object

Metal-clad air-insulated switchgear panel from a 24 kV switchgear type ZS1.2 (T = 1000 mm), drawing-no. GCE 8010459 R0101, with withdrawable vacuum circuit-breaker type VD4 2420-25 and with earthing switch type EK6-2406-275

Ratings of the panel:

Rated voltage	U	24	kV
Rated normal current (tee-off)	I_n	1600	A
Rated frequency	f	50/60	Hz
Rated short-time withstand current	I_{th}	25	kA
Rated peak withstand current	I_p	63	kA
Rated duration of short-circuit current	t_{th}	3	s
Rated short-circuit breaking capacity at 24 kV	I_{sc}	25	kA

Manufacturer

ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen / Germany

Tests performed

Mechanical operation test comprising 50 operations of the vacuum circuit-breaker, 50 operations of the earthing switch, 50 manual operations of the withrawable part and 25 insertions and 25 removals of the removable part. The interlocks of the circuit-breaker, the earthing switch, the withdrawable part and the removable part were tested in the respective position. Test procedure and test parameters were based on
IEC 60298/3rd. Ed./1990/Clause 6.102

Test Specification

IEC 60298/3rd. Ed./1990

Test Results

All switching devices, the withdrawable part, the removable part and the mechanical interlocks passed the mechanical operation test successfully. They were in proper working order and the effort to operate them was practically the same before and after the test.

Test Date

07th September 2000

Client

ABB Calor Emag Mittelspannung GmbH 40472 Ratingen / Germany

18th October 2000
Date of Issue

Laboratory Manager

Test Engineer

Total Number of Sheets: 10 Sheets

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373-03

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT - P - 032/93

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ABB Calor Emag Mittelspannung GmbH Ratingen
Mechanical Testing Laboratory

Oberhausener Str.33
D - 40472 Ratingen

Phone + 49 (0) 21 02 1213 1
Fax + 49 (0) 21 02 12 13

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

1. Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear

Test Object: Metal-clad air-insulated switchgear panel from a 24 kV switchgear

Type: ZS1.2

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen/ Germany

Serial-No.: 7550027/2015/00 **Year of manufacture:** 2000

Drawing Nos.: GCE 8010459 R0101

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current busbar	2500	A
Rated normal current circuit	1600	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s

Prospected values under internal-arc conditions:

Peak withstand current	63	kA
Short-time withstand current	25	kA
Short-circuit duration	3	s

Date of receipt of test object: 24th August 2000

1. Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching Device

Test Object: Withdrawable vacuum circuit-breaker

Type: VD4 2420-25

Vacuum interrupter: VG4S

Manufacturer: ABB Calor Emag Mittelspannung GmbH

Serial-No.: 7008269/4002/00 **Year of manufacture:** 2000

Drawing Nos.:

Withdrawable breaker:	GCE 7000162 R1104
Operating mechanism:	GCE 7179610 R0104
Pole part:	GCE 7005757 R0122
Interrupters:	GCE 7005535 R0102
Pole Centres:	275 mm

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50/60	Hz
Rated normal current	2000	A
Rated short-circuit breaking current	25	kA
Rated short-circuit making current	63	kA
DC-component	30	%
Pole factor	1.5	--
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated operating sequence	O-0,3s-CO-3min-CO	
Rated times of circuit-breaker:		
- opening time	≤ 45	ms
- closing time	approx. 60	ms
Number of poles	3	
Number of units per pole	1	

Date of receipt of test object: 24th August 2000

1. Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching Device

Test Object: Earthing switch

Type: EK6-2406-275

Manufacturer: ABB Calor Emag Mittelspannung GmbH

Serial-No.: 06/052/00 **Year of manufacture:** 2000

Drawing Nos.:

Earthing switch:	GCE 7169312 R0118
Pole Centres:	275 mm

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated power frequency withstand voltage	50	kV
Rated short-circuit making current	63	kA
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s

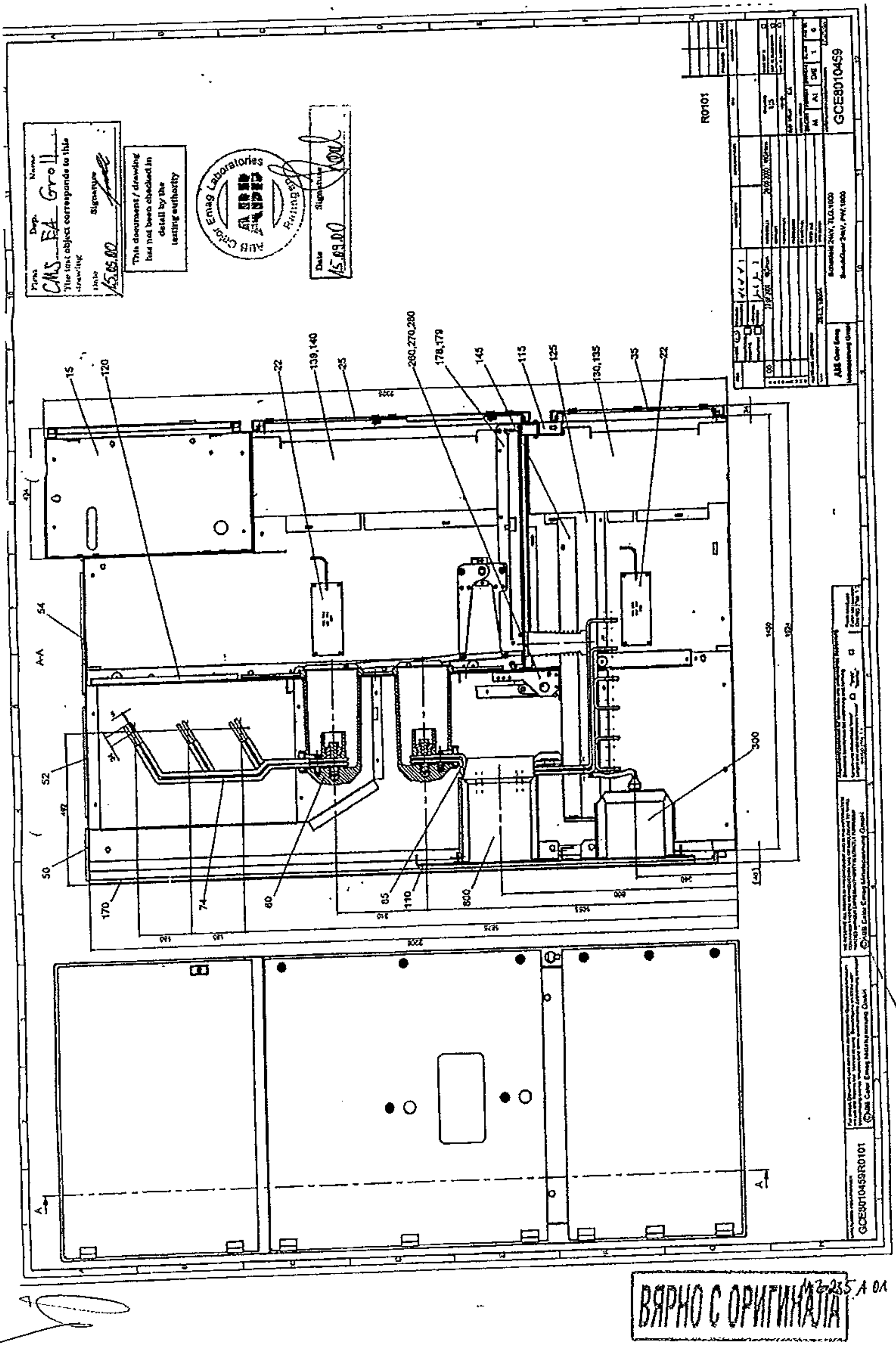
Date of receipt of test object: 24th August 2000

Firma CMS Dep. EA Name Groll
The test object corresponds to this drawing
Date 15.05.00 Signature

This document / drawing has not been checked in detail by the testing authority

ABB Calor Emag Laboratories Ratingen

Date 15.09.00 Signature



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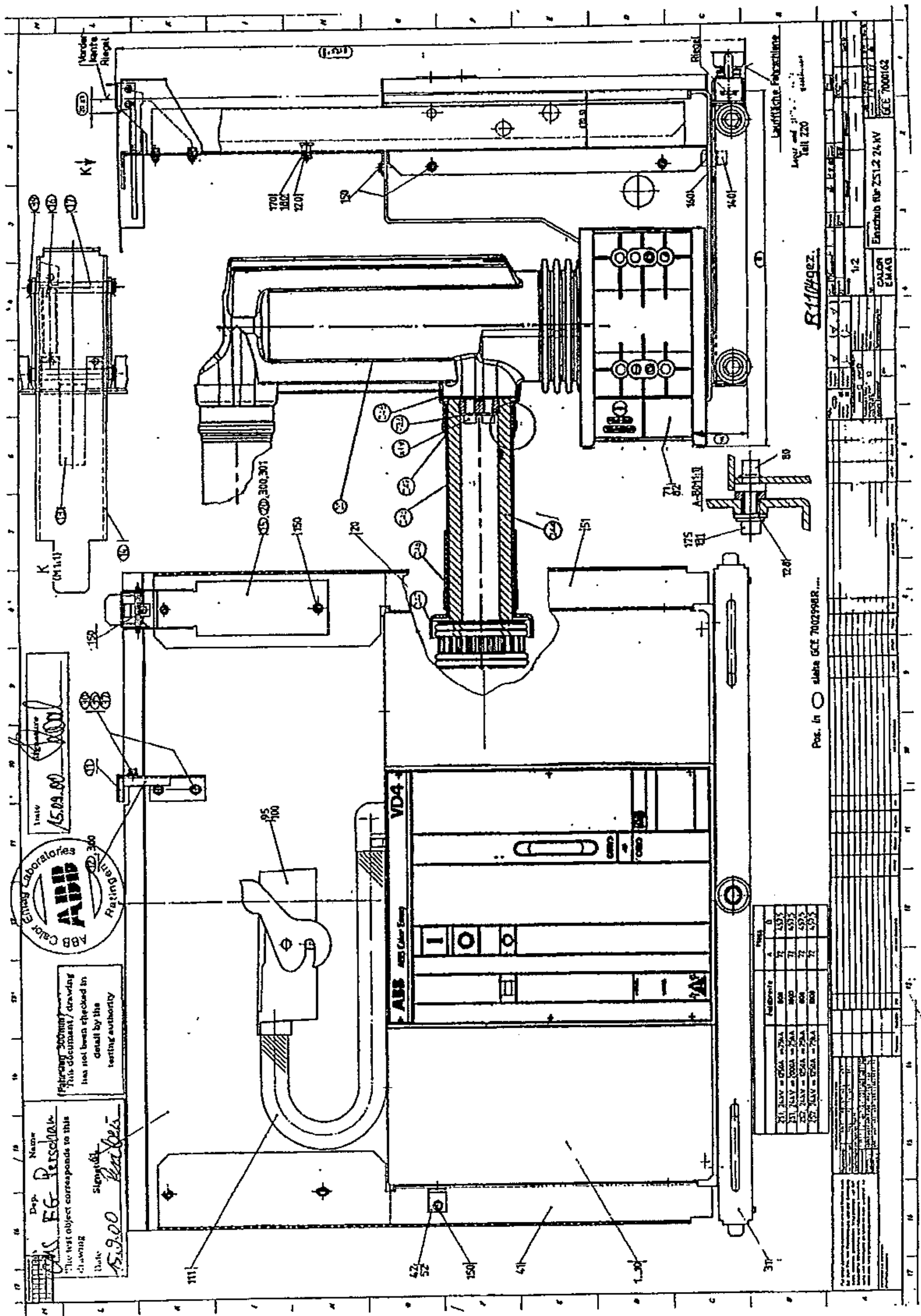


Date 15.09.00
Signature

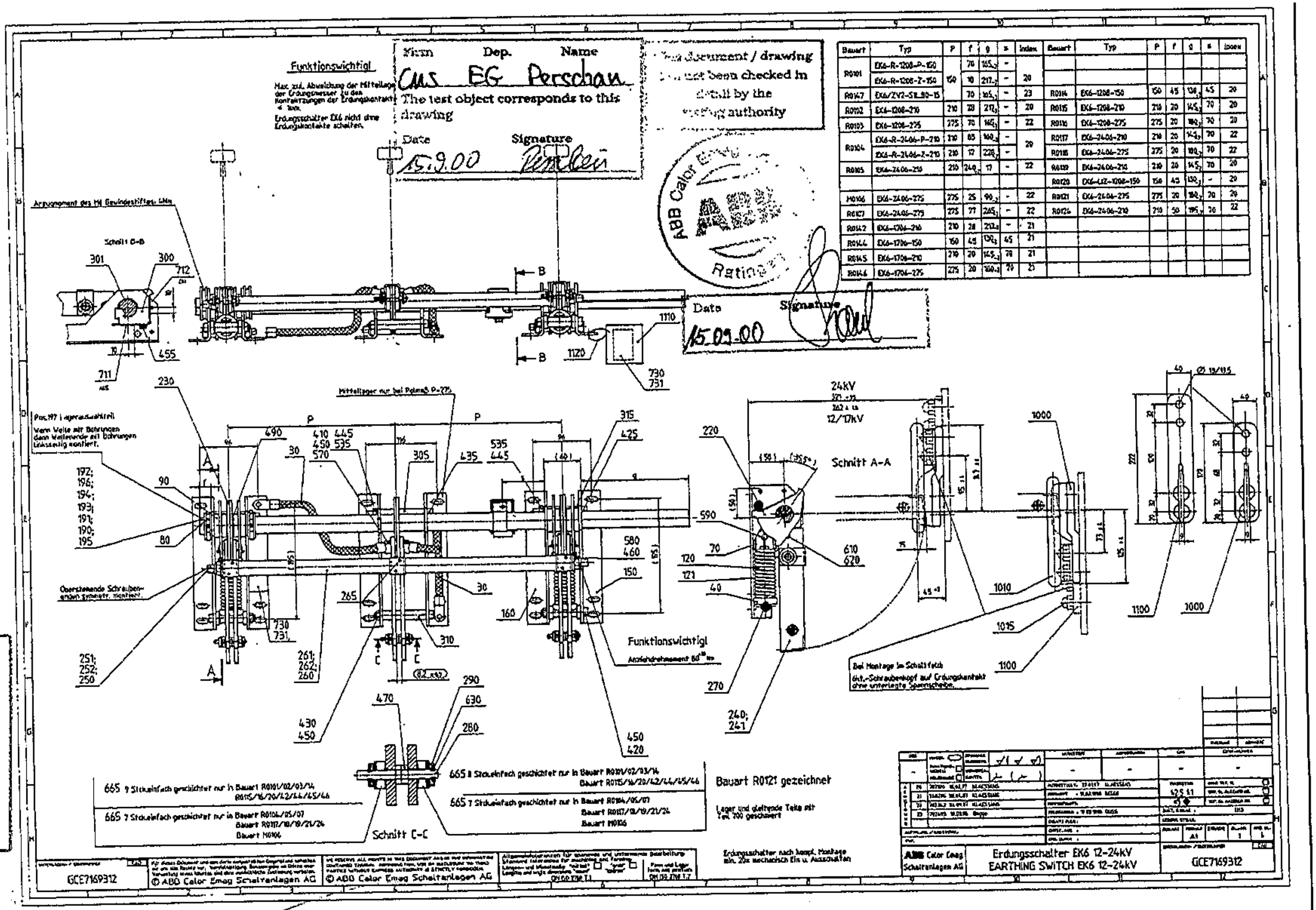
Fabrikat 300mm / This document / drawing has not been checked in detail by the testing authority

The test object corresponds to this drawing
Date 15.9.00
Dep. EG
Name D. Perschak
Signature

ABB Calor Emag Laboratories Ratingen

ВЯРНО С ОРИГИНАЛА

410



Bauart	Typ	P	f	g	s	Index	Bauart	Typ	P	f	g	s	Index
R0101	EK6-R-1208-P-150	150	70	165,5	-	20							
	EK6-R-1208-Z-150		10	217,5	-								
R0147	EK6/ZV2-SIL80-15		70	165,5	-	23	R0114	EK6-1208-150	150	45	130,5	45	20
R0102	EK6-1208-210	210	20	217,5	-	20	R0115	EK6-1208-210	210	20	145,5	70	20
R0103	EK6-1208-275	275	70	160,5	-	22	R0116	EK6-1208-275	275	20	180,5	70	20
R0104	EK6-R-2406-P-210	210	65	160,5	-	20	R0117	EK6-2406-210	210	20	143,5	70	22
	EK6-R-2406-Z-210	210	17	228,5	-		R0118	EK6-2406-275	275	20	100,5	70	22
R0105	EK6-2406-210	210	240,5	17	-	22	R0119	EK6-2406-210	210	20	145,5	70	20
							R0120	EK6-LIZ-1208-150	150	45	130,5	-	20
M0106	EK6-2406-275	275	25	90,5	-	22	R0121	EK6-2406-275	275	20	180,5	70	20
R0107	EK6-2406-275	275	77	265,5	-	22	R0124	EK6-2406-210	210	50	195,5	70	22
R0142	EK6-1706-210	210	28	212,5	-	21							
R0144	EK6-1706-150	150	45	130,5	45	21							
R0145	EK6-1706-210	210	20	145,5	70	21							
R0146	EK6-1706-275	275	20	100,5	70	21							

Firm Dep. Name
CMS EG Perschau
The test object corresponds to this drawing
Date 15.9.00 Signature

This document / drawing has been checked in detail by the testing authority

ABB Calor Emag Ratingen

Date 15.09.00 Signature

ВЯРНО С ОРИГИНАЛА

2. Test Locations and Set-up

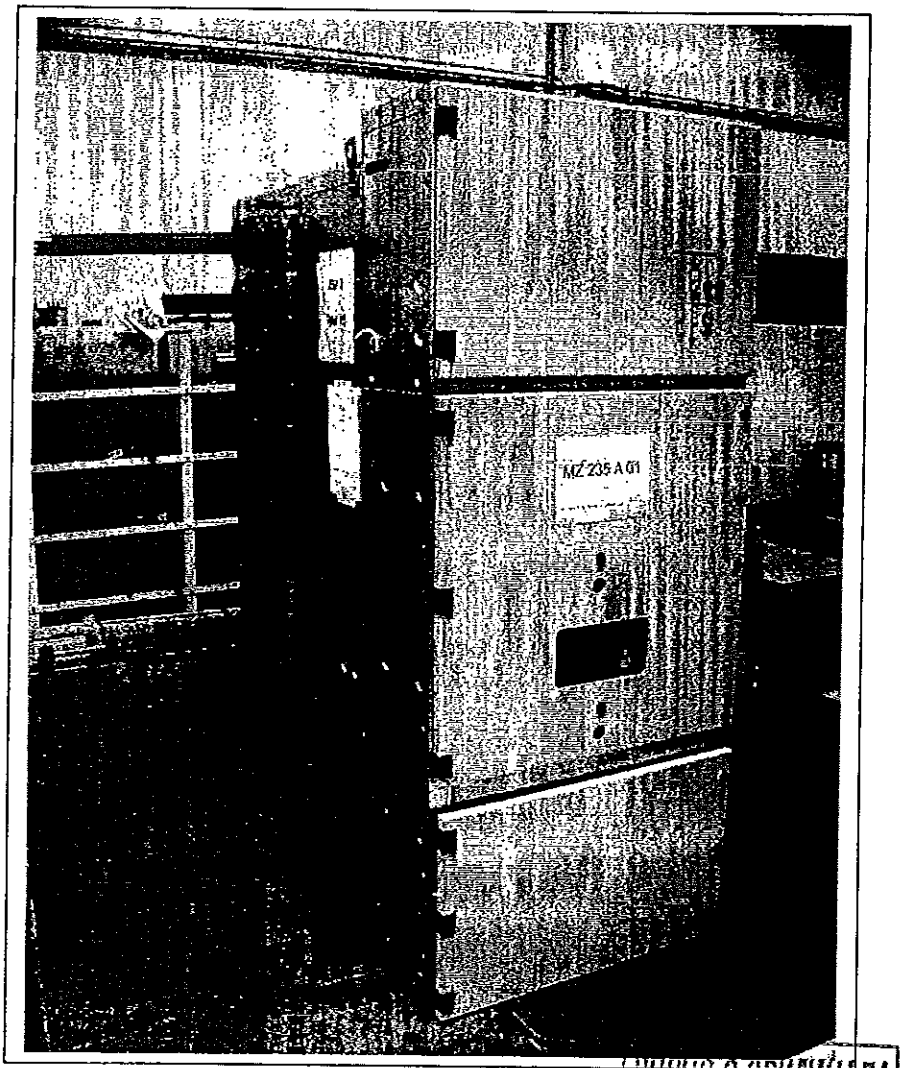
The test was performed in the Mechanical Testing Laboratory

of ABB Calor Emag Mittelspannung GmbH
Dept. LM in Ratingen

at an ambient temperature of approx. 20°C.

Test job no.: 7550027_024A

Test engineer: Koal



3. Mechanical Operation Test

List of interlocks:

1. Withdrawable part in test-position
   - Circuit-breaker ON: prevented to move the withdrawable part in service-position
2. Withdrawable part in service-position
   - Circuit-breaker ON: prevented to move the withdrawable part in test-position
3. Withdrawable part between service and test position:
   - prevented to switch ON the circuit-breaker
4. Withdrawable part in test-position
   - Circuit-breaker OFF and earthing switch ON: prevented to move the withdrawable part in service-position
5. Withdrawable part in test-position
   - circuit-breaker ON and earthing switch ON: prevented to move the withdrawable part in service-position
6. Withdrawable part not in test-position
   - prevented to switch ON the earthing switch
7. Withdrawable part not in test-position
   - prevented to remove the removable part

All the above mentioned interlocks were checked. For this the circuit-breaker, the earthing switch and the withdrawable part were operated 50 times and the removable part was removed and inserted 25 times.

ВЯРНО С ОРИГИНАЛА

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0311 Ra **Copy No.:** 1 **Contents:** 24 Sheets

Equipment under test: Vacuum circuit-breaker type VD4 24.12.20

Manufacturer:

Circuit-breaker: ABB SACE T.M.S. S.p.A., 4 – 24044 Dalmine (BG), Italy

Pole parts inclusive vacuum interrupters: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Germany

Client: ABB T&D SpA, Divisione Sace T.M.S, 4 – 24044 Dalmine (BG), Italy

Testing station: PEHLA - Testing Laboratory Ratingen

Date of test: 03rd February 2003 – 24th February 2003

Applied test specifications:

IEC 62271-100, 1st Ed, 2001-05, clause 6.101.1 and 6.101.2
IEC 60694, Ed.2.2, 2002-01

Tests performed:

In accordance with the requirements of class M2, 10 000 mechanical operating cycles without voltage on or current in the main circuit were carried out with the vacuum circuit-breaker of type VD4 24.12.20 to demonstrate the mechanical reliability.

Test results:

No changes impairing the function of the circuit-breaker were noted after the endurance test. The vacuum circuit-breaker type VD4 24.12.20 passed the mechanical type test successfully.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 24th February 2003

The test results relate only to the items tested.

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ВЯРНО С ОРИГИНАЛА

Deutscher Akkreditierungs Rat
DAR
DAT-P-032/93

03PE0001

Accreditation

The PEHLA-Testing Laboratory Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN ISO/IEC 17025 PEHLA states the following:

- The accreditation of the PEHLA-Testing Laboratory or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Laboratory this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international co-operation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N, S, AIR) and STLNA (USA). In the Framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office:
PEHLA-Geschäftsstelle
Hallenweg 40
68219 Mannheim; Germany

Testing Station:
PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen; Germany

Manufacturer:
ABB SACE T.M.S. S.p.A.
Via Friuli
4 – 24044 Dalmine (BG), Italy

ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
40472 Ratingen, Germany

Client:
ABB SACE T.M.S. S.p.A.
Via Friuli
4 – 24044 Dalmine (BG), Italy

ВЯРНО С ОРИГИНАЛА

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List of Test Participants

Representatives of the Test Committee:

Mr. G. Heit	PEHLA-Testing Laboratory Mannheim
Mr. U. Köster	PEHLA-Testing Laboratory Ratingen

Test Operator:

Mr. M. Schöttler	PEHLA-Testing Laboratory Ratingen
Mr. J. Mendorf	PEHLA-Testing Laboratory Ratingen
Mr. A. Piglas	PEHLA-Testing Laboratory Ratingen

Representatives of the Client:

Mr. S. Magoni	ABB SACE T.M.S. S.p.A., Italy

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4 24.12.20
Manufacturer:
Circuit-breaker: ABB SACE T.M.S. S.p.A., 4 – 24044 Dalmine (BG), Italy
Pole parts including vacuum interrupters: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Germany
Serial-No.: AD00003052 **Year of manufacture:** 2003
Drawing No.: TN. 7410 (circuit-breaker)
Vacuum interrupter: Type: VG4, L1: No. 1154/3, L2: No. 1135/3, L3: No. 0288/3
Drawing No.: GCE 7004730R0105 (pole part)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	50	kA
Rated short-time withstand current	20	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current at 12 kV	20	kA
D.C. component	30	%
Rated short-circuit making current at 12 kV	50	kA
Rated transient recovery voltage:		
Peak value	20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	110	V-DC
Rated voltage of closing coil	110	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz

Essential characteristics and installed devices:

The circuit-breaker was not equipped with the auxiliary switch BS2 for the spring-charged-signal.
Motor Drive Type 701 921/803, Serial No. CA2 7GL 02 C (EL1).

Date of receipt of test object: 3rd February 2003

ВЯРНО С ОРИГИНАЛА

List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represent the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

☒ with the test documents at the test laboratory.
☐ at the client.

The drawings contained in this document are identical with the checked, stamped and signed drawings.

Drawing-No.	Revision	Title	Additional remarks
TN 7410	M5234 02-10-10	Vaccum Circuit Breaker Type VD4 24kV 630-1250A	Included in test report
510507	50538 02-12-13	Assieme Comando Operating Mechanism Assembly	Included in test report
GCE7004730	09	Pol vst. VD4P 24kV 1250A Pole complete VD4P 24kV 1250A	Included in test report
Parts list			
510564		Ass. molle di ch. com. EL1	—
510507		Assieme commando EL1	—
GCE7004730R0104		Pol vst. 40,7 2400N H310 2412-20 VG4	—

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0.3.14 R.A

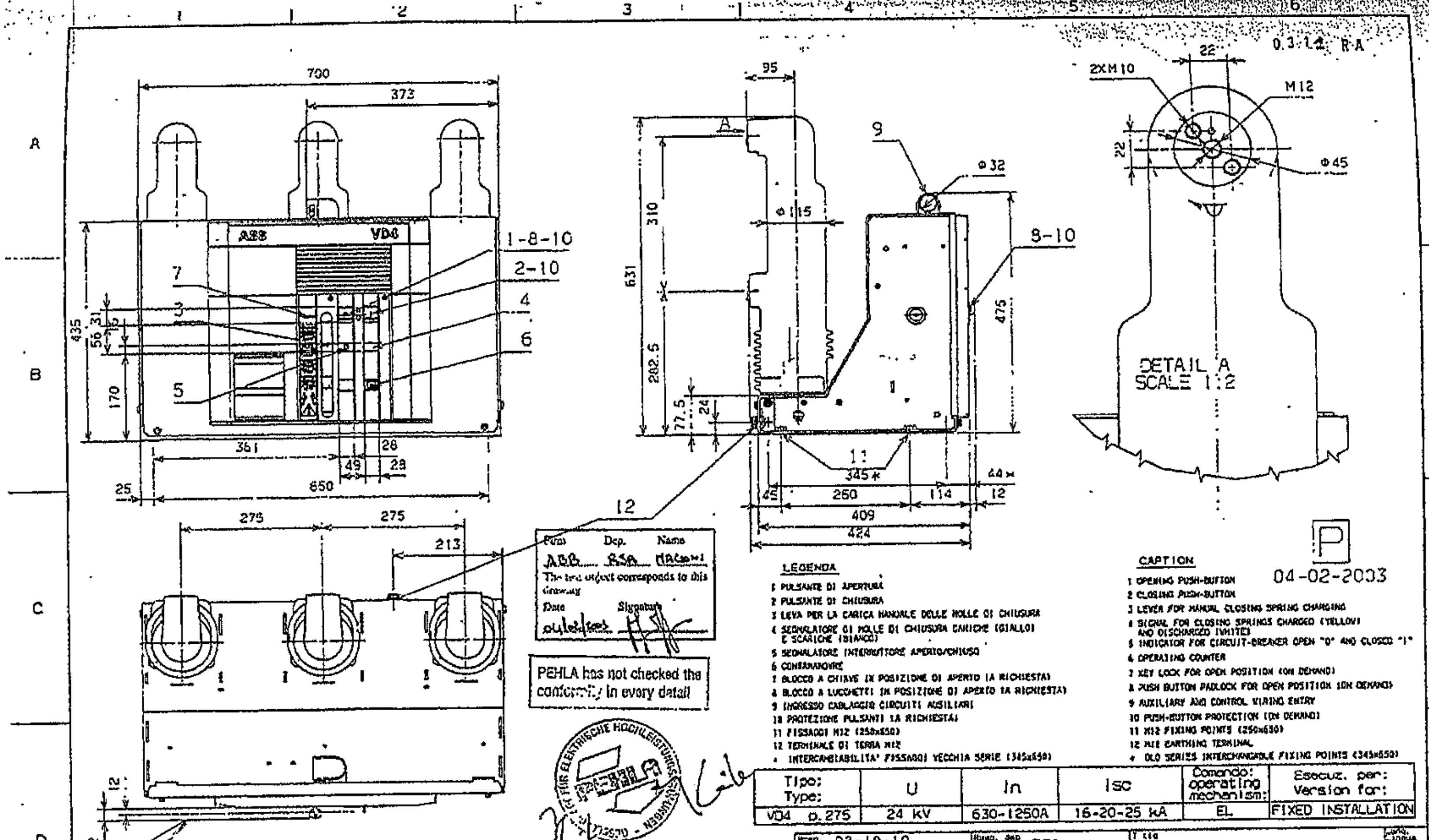

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ABB	RSA	[illegible]

The test object corresponds to this drawing

Date 04/02/03 Signature

PEHLA has not checked the conformity in every detail

P
04-02-2003

LEGENDA

1 PULSANTE DI APERTURA
2 PULSANTE DI CHIUSURA
3 LEVA PER LA CARICA MANUALE DELLE MOLLE DI CHIUSURA
4 SEGNALATORE DI MOLLE DI CHIUSURA CARICHE (GIALLO) E SCARICHE (BIANCO)
5 SEGNALATORE INTERRUTTORE APERTO/CHIUSO
6 CONTAMANOVRE
7 BLOCCO A CHIAVE IN POSIZIONE DI APERTO (A RICHIESTA)
8 BLOCCO A LUCCHETTI IN POSIZIONE DI APERTO (A RICHIESTA)
9 INGRESSO CABLAGGIO CIRCUITI AUSILIARI
10 PROTEZIONE PULSANTI (A RICHIESTA)
11 FISSAGGI M12 (250x650)
12 TERMINALE DI TERRA M12
* INTERCAMBIABILITA' FISSAGGI VECCHIA SERIE (345x650)

CAPTION

1 OPENING PUSH-BUTTON
2 CLOSING PUSH-BUTTON
3 LEVER FOR MANUAL CLOSING SPRING CHARGING
4 SIGNAL FOR CLOSING SPRINGS CHARGED (YELLOW) AND DISCHARGED (WHITE)
5 INDICATOR FOR CIRCUIT-BREAKER OPEN "0" AND CLOSED "I"
6 OPERATING COUNTER
7 KEY LOCK FOR OPEN POSITION (ON DEMAND)
8 PUSH BUTTON PADLOCK FOR OPEN POSITION (ON DEMAND)
9 AUXILIARY AND CONTROL WIRING ENTRY
10 PUSH-BUTTON PROTECTION (ON DEMAND)
11 M12 FIXING POINTS (250x650)
12 M12 EARTHING TERMINAL
* OLD SERIES INTERCHANGABLE FIXING POINTS (345x650)

Tipo: Type:	U	In	Isc	Comando: operating mechanism:	Esecuz. per: Version for:
VD4 p.275	24 kV	630-1250A	16-20-25 kA	EL	FIXED INSTALLATION

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Prep. Dis. 02-10-10 G.Sala	Resp. dep. Uff. Resp. RSA	Title Titolo VACUUM CIRCUIT BREAKER TYPE VD4 24KV 630-1250A	Lang. Lingua It-En
App. App. Prestini	Take over doc Uff. Uti Izz.		
Rev. Mod. H5234 02-10-10		Apparatus Apparecchio VD4	Scale Scala –
ABB	ABB SACE T.M.S.	Doc. No. N° Doc. TN. 7410	N. Pag. 1/1

FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

ВЯРНО С ОРИГИНАЛА

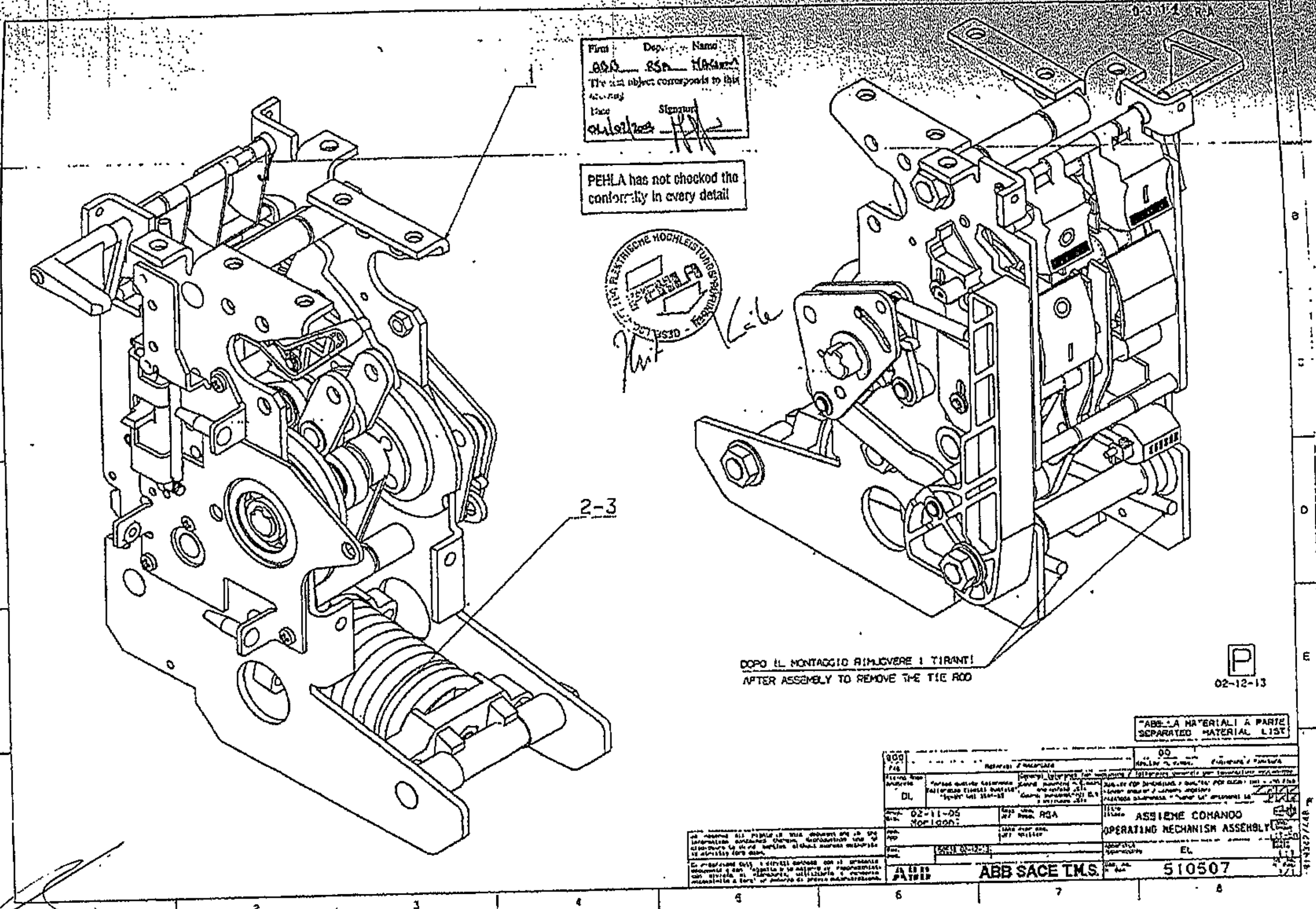
0-3-11/4 RA

First	Dep.	Name
ABB	RSA	[illegible]

The test object corresponds to this drawing

Date: 04/08/2003 Signature

PEHLA has not checked the conformity in every detail



DOPO IL MONTAGGIO RIMUOVERE I TIRANTI

AFTER ASSEMBLY TO REMOVE THE TIE ROD

TABELLA MATERIALI A PARTE
SEPARATED MATERIAL LIST

800		00
DL		
02-11-05 Morigoni	RSA	ASSIEME COMANDO OPERATING MECHANISM ASSEMBLY
		EL
ABB	ABB SACE T.M.S.	510507

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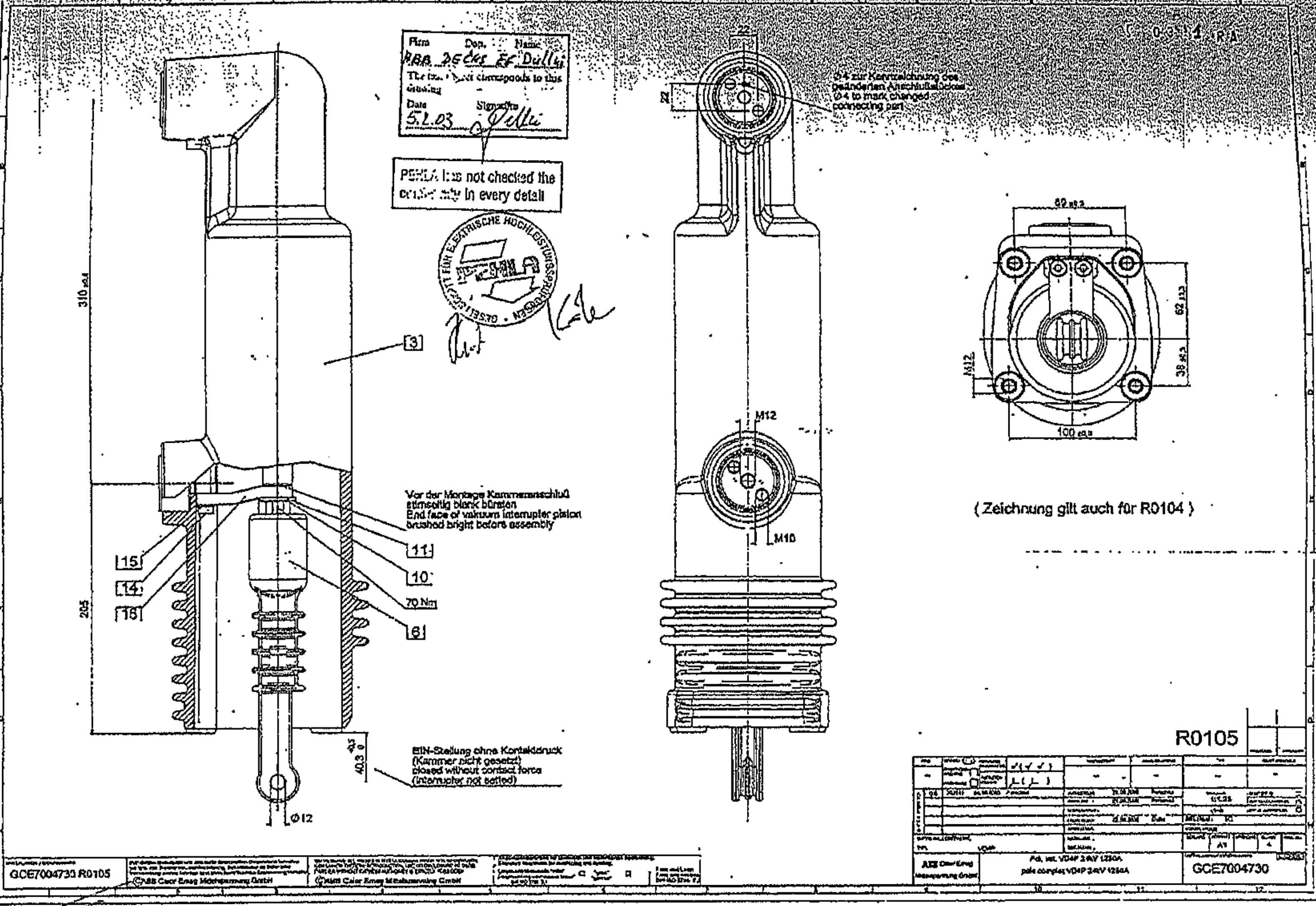


Firm ABB Dep. DECMS EF Name Dulli
The test object corresponds to this drawing
Date 5.2.03 Signature Dulli

PEHLA has not checked the drawing in every detail

ВЯРНО С ОРИГИНАЛА

Details on Performance of the Test

Prior to the endurance test, the following electrical and mechanical data were determined by measurements on the circuit-breaker and its auxiliary systems:

a) closing time (5 times *)
b) opening time (5 times *)
c) time spread between units of one pole - not applicable
d) time spread between poles (5 times *)
e) charging time of the motorized operating mechanism (5 times *)
f) consumption of the motorized operating mechanism (5 times *)
g) consumption of the tripping devices (5 times *)
h) duration of opening and closing command impulse
i) tightness
j) gas densities or pressures - not applicable
k) resistance of the main circuit (5 times *)
l) time-travel chart (5 times *)
m) other important characteristics
  - contact travel
  - check of vacuum of interrupters
  - verification of the rated operating sequence (refer to clause 6.101.2.5 a))
  - ambient atmospheric conditions

*) 5 times at rated, minimum and maximum supply voltage.

The subsequent endurance test comprising 10 000 mechanical operating cycles was structured as follows and carried out five times:

500 operating cycles with operating sequence C - 90 s - O - 90 s at the minimum supply voltage of closing and opening devices and motorized operating mechanism and the minimum pressure for operation

500 operating cycles with operating sequence C - 90 s - O - 90 s at the rated supply voltage of closing and opening devices and motorized operating mechanism and the rated pressure for operation

500 operating cycles with operating sequence C - 90 s - O - 90 s at the maximum supply voltage of closing and opening devices and motorized operating mechanism and at the maximum pressure for operation

250 operating cycles with operating sequence C - 90 s - O - 300 ms - CO - 270 s at the rated supply voltage of closing and opening devices and motorized operating mechanism and at the rated pressure for operation

After each series of 2 000 operating sequences the operating characteristics: a), b), d), e), and l) as listed above have been recorded.

Following the endurance test, the measurements carried out before the mechanical endurance test were measured again for comparison. Check, whether the travel characteristics fell within the envelope curves, taken before the endurance test.

ВЯРНО С ОРИГИНАЛА

Results of measurements before the mechanical endurance test

Number of operations: counter: 00035

a/b) Opening and closing time:

Rated supply voltage of closing and opening devices: Ua = 110 V DC
Operating time [ms]

measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	t_O (opening)			t_C (closing)		
U [V]	0.7 x Ua	1.0 x Ua	1.1 x Ua	0.85 x Ua	1.0 x Ua	1.1 x Ua
t [ms]	80.4	53.1	50.4	72.3	66.0	63.3
	79.8	53.4	50.1	72.3	66.3	63.3
	79.8	53.4	50.1	72.3	66.0	63.3
	79.8	53.4	50.1	72.3	66.0	63.6
	80.4	53.4	50.1	72.3	66.0	63.3

d) Time spread between the breaker poles:

The time spread between the breaker poles on closing and on opening of the circuit-breaker was measured to < 2 ms.

e/f) Charging time and power consumption of the motorized operating mechanism:

Rated supply voltage of motor charging: Ua = 220 V DC

Measured values:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

motor voltage	charging time after O-C operation [s]					current consumption [A]					power consumption [W]				
U = 0.85 x Ua = 187 V DC	3.57	3.71	3.71	3.78	3.71	0.95	0.97	0.98	0.98	0.97	178	181	183	183	181
U = 1.0 x Ua = 220 V DC	2.94	3.00	2.94	2.96	2.97	0.99	0.98	0.96	0.99	0.98	218	216	211	218	216
U = 1.1 x Ua = 242 V DC	2.59	2.54	2.53	2.53	2.50	1.00	0.99	0.99	0.98	0.97	242	240	240	237	234

ВЯРНО С ОРИГИНАЛА

g) Consumption of the tripping devices:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON YC					Shunt-release OFF YO1				
Rated operating voltage U_a	110 V DC					110 V DC				
Current at minimum supply voltage [A]	1.24	1.24	1.24	1.24	1.24	0.90	0.92	0.92	0.92	0.92
Current at rated supply voltage [A]	1.52	1.56	1.52	1.52	1.52	1.24	1.20	1.20	1.24	1.20
Current at maximum supply voltage [A]	1.68	1.72	1.72	1.72	1.68	1.36	1.36	1.36	1.36	1.36

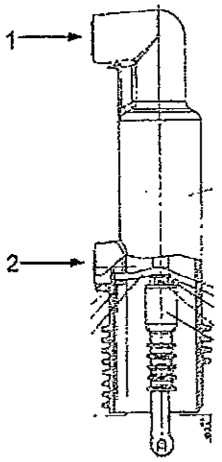
h) Duration of opening and closing command impulse:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON YC					Shunt-release OFF YO1				
Duration of command impulse at minimum supply voltage [ms]	74.6	75.0	74.7	74.7	74.7	80.7	80.1	80.4	84.9	80.4
Duration of command impulse at rated supply voltage [ms]	70.5	69.6	69.3	69.3	69.3	54.9	54.9	54.9	54.9	54.9
Duration of command impulse at maximum supply voltage [ms]	67.2	67.2	67.5	67.5	67.5	52.5	52.2	52.2	51.9	52.2

k) Resistance of the main conductors:

Measuring points:



ВЯРНО С ОРИГИНАЛА

Contact resistance measured during the 5 x CO operations at the minimum supply voltage of the coils:

Measuring points	L1 μΩ					L2 μΩ					L3 μΩ				
1 - 2	16.9	16.9	16.9	17.0	17.0	16.6	16.6	16.6	16.6	16.6	17.1	17.2	17.2	17.2	17.2

Contact resistance measured during the 5 x CO operations at the rated supply voltage of the coils:

Measuring points	L1 μΩ					L2 μΩ					L3 μΩ				
1 - 2	16.9	16.9	16.9	16.9	16.9	16.6	16.6	16.6	16.6	16.6	17.2	17.2	17.2	17.2	17.2

Contact resistance measured during the 5 x CO operations at the maximum supply voltage of the coils:

Measuring points	L1 μΩ					L2 μΩ					L3 μΩ				
1 - 2	17.0	16.9	17.0	17.0	17.0	16.6	16.6	16.6	16.6	16.7	17.2	17.2	17.2	17.2	17.2

l) Time-travel chart with opening and closing speed: **See diagram 1.1 and 1.2**

Speed in [m/s]; Ua = 110 V DC
at U = 1.0 x Ua

	V_{O1}		V_C
L2	1.18	1.35	0.97

The deviations from the measured mechanical time travel charts are in the allowable limits of the reference mechanical travel characteristics.

m) Other important characteristics:

- **Contact travel:**

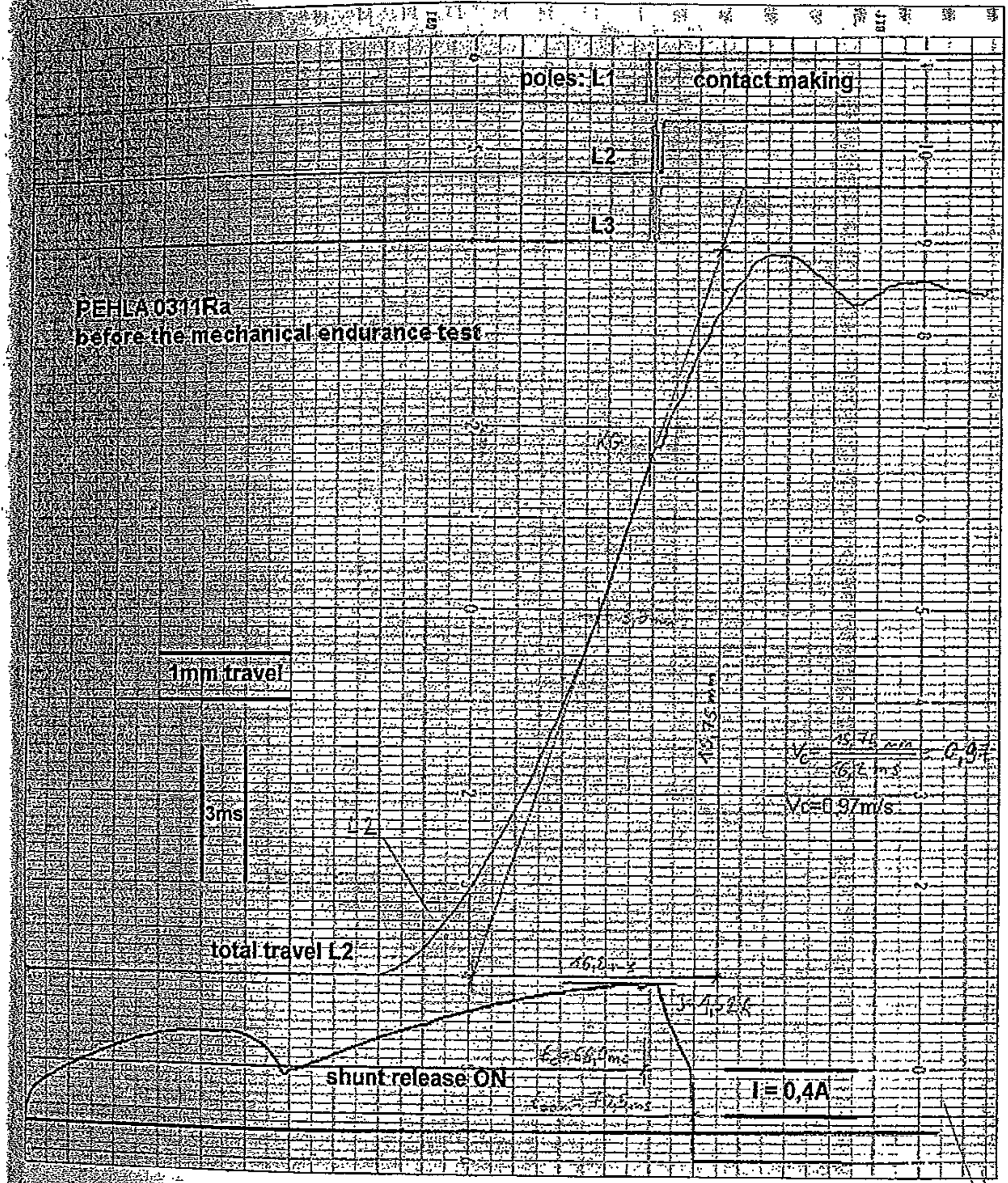
	L1	L2	L3
Total Travel [mm]	15.0	15.0	15.1
Cont.-travel [mm]	11.3	11.3	11.2
Contact-spring travel [mm]	3.7	3.7	3.9

- **Check of vacuum of interrupters:**
  60 kV DC ok
- **Verification of the rated operating sequence:**
  O-0.3s-CO-3min-CO at rated voltage ok
- **Ambient atmospheric conditions:**
  Date: 04th February 2003, ambient air temperature: approx. 22°C

ВЯРНО С ОРИГИНАЛА

3

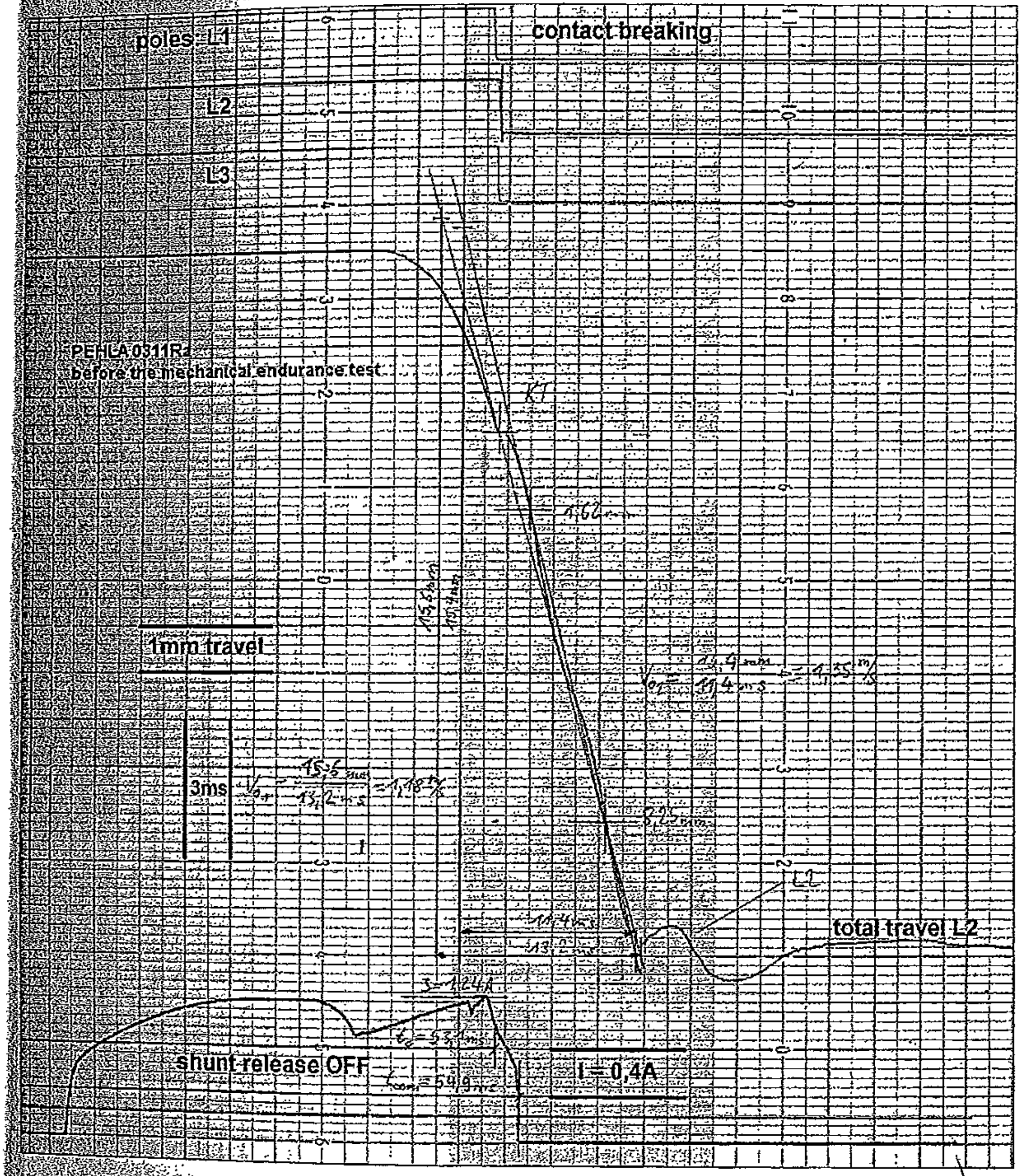
Diagram 1.1: Measurement of the operating speed before the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2
Operating speed measured: V_c = 0.97 m/s at U = 1.0 x Ua

ВЯРНО С ОРИГИНАЛА

Diagram 1.2: Measurement of the operating speed before the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2

Operating speed measured: V_{O1} = 1.18 m/s V_{O2} = 1.35 m/s at U = 1.0 x Ua

ВЯРНО С ОРИГИНАЛА

Results of measurements during the mechanical endurance test

a/b) Opening and closing time:

Operating time [ms] Ua = 110 V DC		t_{O1} (opening)			t_C (closing)		
	U [V]	0.7 x Ua	1.0 x Ua	1.1 x Ua	0.85 x Ua	1.0 x Ua	1.1 x Ua
Number of operations: 2 000	t [ms]	82.2	53.7	50.4	72.0	66.0	63.0
Number of operations: 4 000	t [ms]	79.5	53.7	50.4	72.9	66.3	63.3
Number of operations: 6 000	t [ms]	78.0	53.4	50.4	72.9	66.6	64.2
Number of operations: 8 000	t [ms]	78.6	53.7	50.7	72.9	66.6	64.0

d) Time spread between the breaker poles:

The time spread between the breaker poles on closing and on opening of the circuit-breaker was measured to < 2 ms.

e) Charging time of the motorized operating mechanism:

	charging time for O1-C [s]		
Motor voltage Ua = 220 V DC	U = 0.85 x Ua = 187 V DC	U = 1.0 x Ua = 220 V DC	U = 1.1 x Ua = 242 V DC
Number of operations: 2 000	3.64	2.99	2.47
Number of operations: 4 000	3.87	3.12	2.68
Number of operations: 6 000	3.80	3.06	2.69
Number of operations: 8 000	3.81	3.03	2.65

m) Other important characteristics- contact travel:

Contact travel in L2	Total Travel [mm]
Number of operations: 2 000	14.8
Number of operations: 4 000	14.7
Number of operations: 6 000	14.7
Number of operations: 8 000	14.7

l) Time-travel chart with opening and closing speed:

Speed in [m/s]; at Ua = 110 V DC L2	V_{O1}		V_C
	8.25	**6.6 mm**	
Number of operations: 2 000	1.12	1.29	0.91
Number of operations: 4 000	1.11	1.29	0.91
Number of operations: 6 000	1.08	1.24	0.91
Number of operations: 8 000	1.13	1.32	0.93

The deviations from the measured mechanical time travel charts are in the allowable limits of the reference mechanical travel characteristics.

ВЯРНО С ОРИГИНАЛА

Results of measurements after the mechanical endurance test

Number of operations counter: 10 199

a/b) Opening and closing time:

Rated supply voltage of closing and opening devices Ua = 110 V DC
Operating time [ms]

measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	t$_0$ (opening)			t$_c$ (closing)		
U [V]	0.7 x Ua	1.0 x Ua	1.1 x Ua	0.85 x Ua	1.0 x Ua	1.1 x Ua
t [ms]	80.1	55.5	50.7	73.5	67.5	63.3
	79.8	54.0	51.0	73.5	67.5	63.3
	80.1	55.2	51.6	73.5	66.3	63.9
	79.8	54.0	51.0	74.1	66.6	63.9
	79.2	53.4	50.7	72.9	67.5	64.2

d) Time spread between the breaker poles:

The time spread between the breaker poles on closing and on opening of the circuit-breaker was measured to < 2 ms.

e/f) Charging time and power consumption of the motorized operating mechanism:

Rated supply voltage of motor charging: Ua = 220 V DC

Measured values:

Measured during the 5 x CO operations
at the minimum supply voltage
at the rated supply voltage
at the maximum supply voltage

motor voltage	**charging time after O-C operation [s]**					**current consumption [A]**					**power consumption [W]**				
U = 0.85 x Ua = 187 V DC	3.60	3.78	3.80	3.86	3.83	0.93	0.92	0.95	0.94	0.93	174	172	178	176	174
U = 1.0 x Ua = 220 V DC	3.03	2.86	2.83	2.90	2.93	0.94	0.93	0.92	0.94	0.95	207	205	202	207	209
U = 1.1 x Ua = 242 V DC	2.59	2.71	2.69	2.65	2.68	0.90	0.96	0.96	0.95	0.96	218	232	232	230	232

ВЯРНО С ОРИГИНАЛА

g) Consumption of the tripping devices:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON YC					Shunt-release OFF YO1				
Rated operating voltage U_r	110 V DC					110 V DC				
Current at minimum supply voltage [A]	1.24	1.28	1.28	1.28	1.28	0.92	0.92	0.92	0.92	0.92
Current at rated supply voltage [A]	1.56	1.52	1.52	1.52	1.52	1.20	1.20	1.20	1.20	1.20
Current at maximum supply voltage [A]	1.72	1.72	1.72	1.72	1.72	1.36	1.36	1.36	1.32	1.32

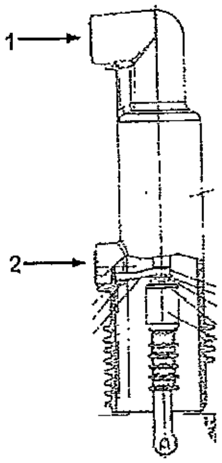
h) Duration of opening and closing command impulse:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON YC					Shunt-release OFF YO1				
Duration of command impulse at minimum supply voltage [ms]	75.9	76.2	76.2	76.8	75.3	79.8	79.8	80.1	79.8	79.2
Duration of command impulse at rated supply voltage [ms]	71.4	71.4	69.9	70.5	71.1	56.7	55.5	57.0	55.5	54.6
Duration of command impulse at maximum supply voltage [ms]	67.8	67.8	68.4	68.4	68.7	52.5	52.8	53.4	52.5	52.8

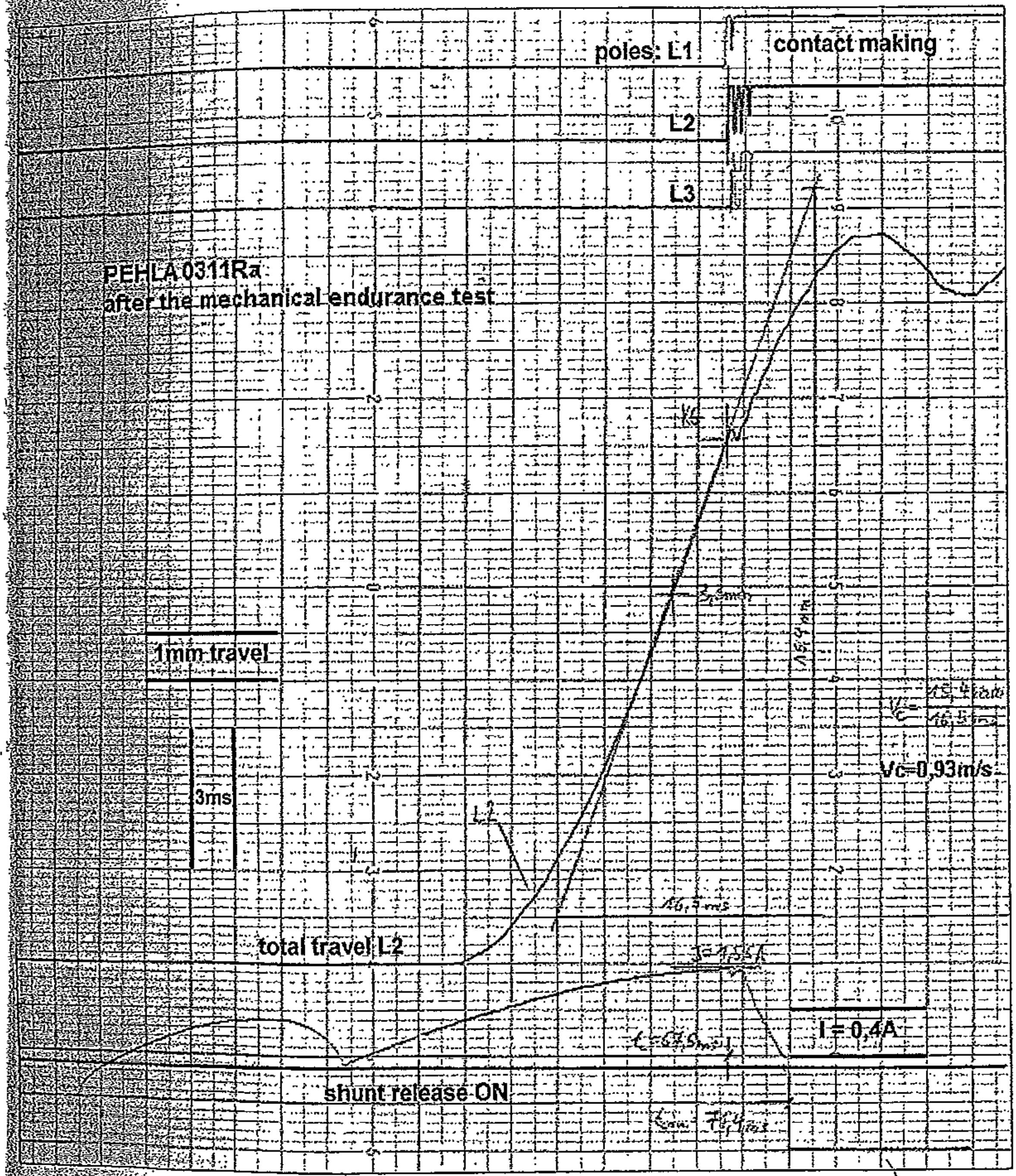
k) Resistance of the main conductors:

Measuring points:



ВЯРНО С ОРИГИНАЛА

Diagram 2.1: Measurement of the operating speed after the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2

Operating speed measured: $V_c = 0.93$ m/s at U = 1.0 x Ua

ВЯРНО С ОРИГИНАЛА

3

Contact resistance measured during the 5 x CO operations at the minimum supply voltage of the coils:

Measuring points	L1 µΩ					L2 µΩ					L3 µΩ				
1 - 2	17.1	17.1	17.2	17.1	17.1	16.9	16.9	16.9	16.9	16.8	17.7	17.7	17.7	17.7	17.8

Contact resistance measured during the 5 x CO operations at the rated supply voltage of the coils:

Measuring points	L1 µΩ					L2 µΩ					L3 µΩ				
1 - 2	17.3	17.2	17.2	17.2	17.2	16.9	17.0	16.9	16.9	16.9	17.7	17.7	17.7	17.8	17.8

Contact resistance measured during the 5 x CO operations at the maximum supply voltage of the coils:

Measuring points	L1 µΩ					L2 µΩ					L3 µΩ				
1 - 2	17.1	17.1	17.1	17.1	17.1	16.9	17.0	17.0	17.0	17.0	17.7	17.7	17.7	17.7	17.7

l) Time-travel chart with opening and closing speed: See diagram 2.1 and 2.2

Speed in [m/s]; Ua = 110 V DC
at U = 1.0 x Ua

	V_O		V_C
L2	1.12	1.25	0.93

The deviations from the measured mechanical time travel charts are in the allowable limits of the reference mechanical travel characteristics.

m) Other important characteristics:

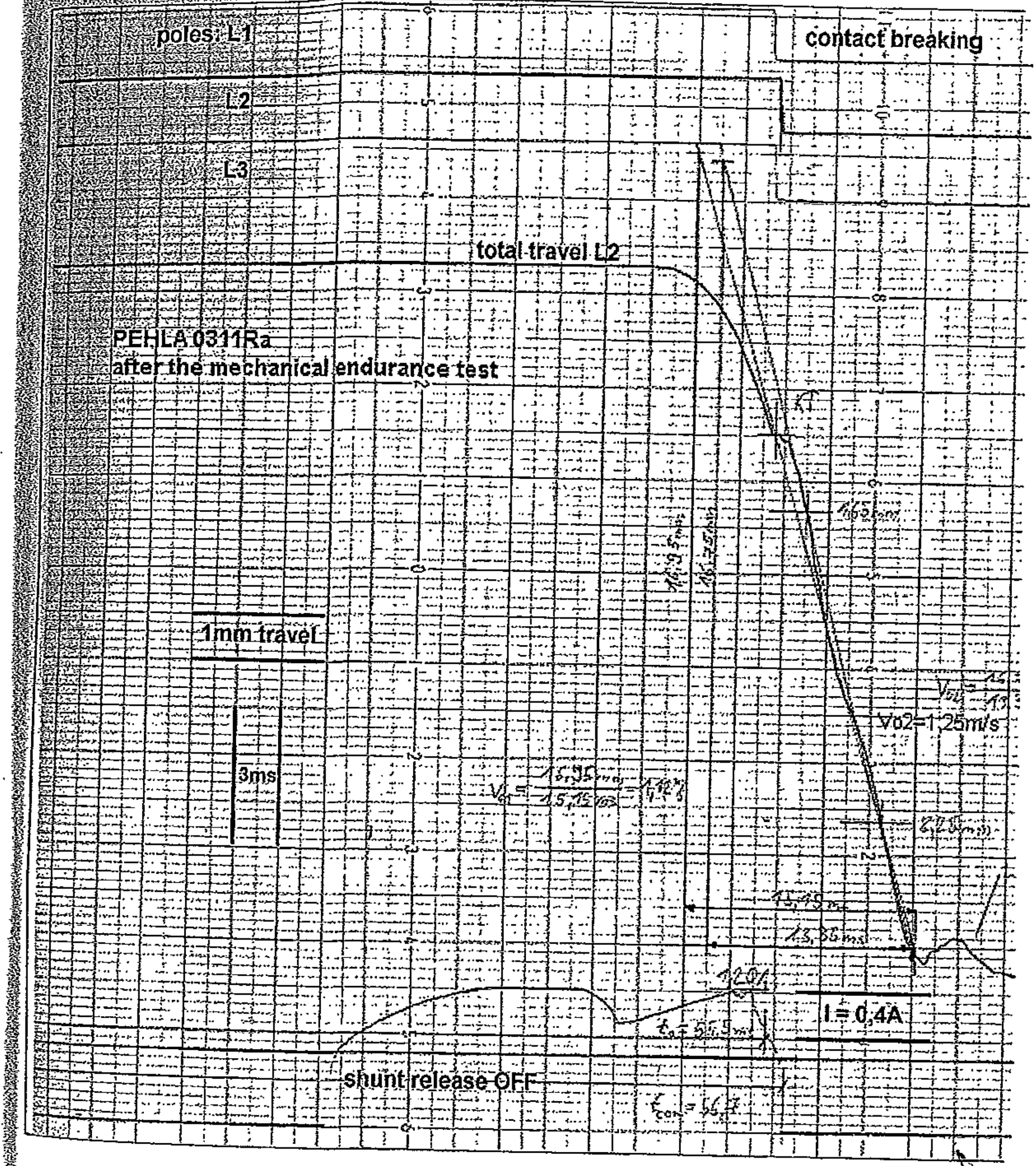
- **Contact travel:**

	L1	L2	L3
Total Travel [mm]	14.6	14.6	14.7
Cont.-travel [mm]	11.2	11.1	11.2
Contact-spring travel [mm]	3.4	3.5	3.5

- **Check of vacuum of interrupters:**
  60 KV DC ok
- **Verification of the rated operating sequence:**
  O-0.3s-CO-3min-CO at rated voltage ok
- **Ambient atmospheric conditions:**
  Date: 24th February 2003, ambient air temperature: approx. 22°C

ВЯРНО С ОРИГИНАЛА

Diagram 2.2: Measurement of the operating speed after the mechanical endurance test



- Measuring point: Insulated coupling rod in phase L2
- Operating speed measured: V_{O1} = 1.12 m/s V_{O2} = 1.25 m/s at U = 1.0 x Ua

ВЯРНО С ОРИГИНАЛА

Evaluation of the measurements before and after the test program

The reference mechanical travel characteristic was recorded at the rated supply voltage before the endurance test. All measured travel-curves fall within the limits of the two envelope curves which characterize the allowable deviations from the reference curve.

All characteristics measured before and after the test program do not show unacceptable variations.

The circuit-breaker operated only on command and did not operate without command.

ВЯРНО С ОРИГИНАЛА

Measuring Instrument Record

Test job no.: 8002374_M06

Test object: VD4 24.12.20

Date of test: 03rd Feb. – 24th Feb. 2003

Test report No: 0311Ra

Test operator: Mendorf / Schöttler

Instrument	Ident.-no.	Measuring	Remarks
Microohmmeter MO2A 50	ELK 001111	20µΩ / 200µΩ	Resistance measurement
resistive travel pick-up type lino pot Ts 50 502	ELK 001024	5 kΩ	Travel time measurement
DM 7100 Transient memory	ELK 000466	±2 V / full scale 50µs/word, channel 4 (12 bit)	
YEW-3063 Multi-pen	ELK 000464	0.25 V/cm-vernier 10 cm/min, channel 4	
Slide caliper rule	LAE 002162	0 - 300 mm	
Shunt 1.5A/150mV	ELK 001044	1.5A/150mV	Current measurement (y2/y3)
DM 7100 Transient memory	ELK 000466	±20/0.2 V/full scale 50 µsec/word/10ms/word channel 1, 2, 3, 8 (8 bit)	Operating time measurement,
YEW-3063 Multi-pen	ELK 000464	Channel 1, 2, 3, 8, 0.25/1 V/cm-cal/vernier 10 cm/min	
Electronic time clock	ELK 001231	0-100s	Charging time measurement
nigor 6E	ELK 000389	1 A	Motor current measurement
dar-Vacuum-Checker-Test device	DRU 000026	40/60kV DC	Vacuum-Checker-Test
BBC M2110	ELK 000359	300 V DC	Voltage measurement
Hygrometer Hygronom	FEU 000022	-30°C - +50°C	temperature measurement

ВЯРНО С ОРИГИНАЛА

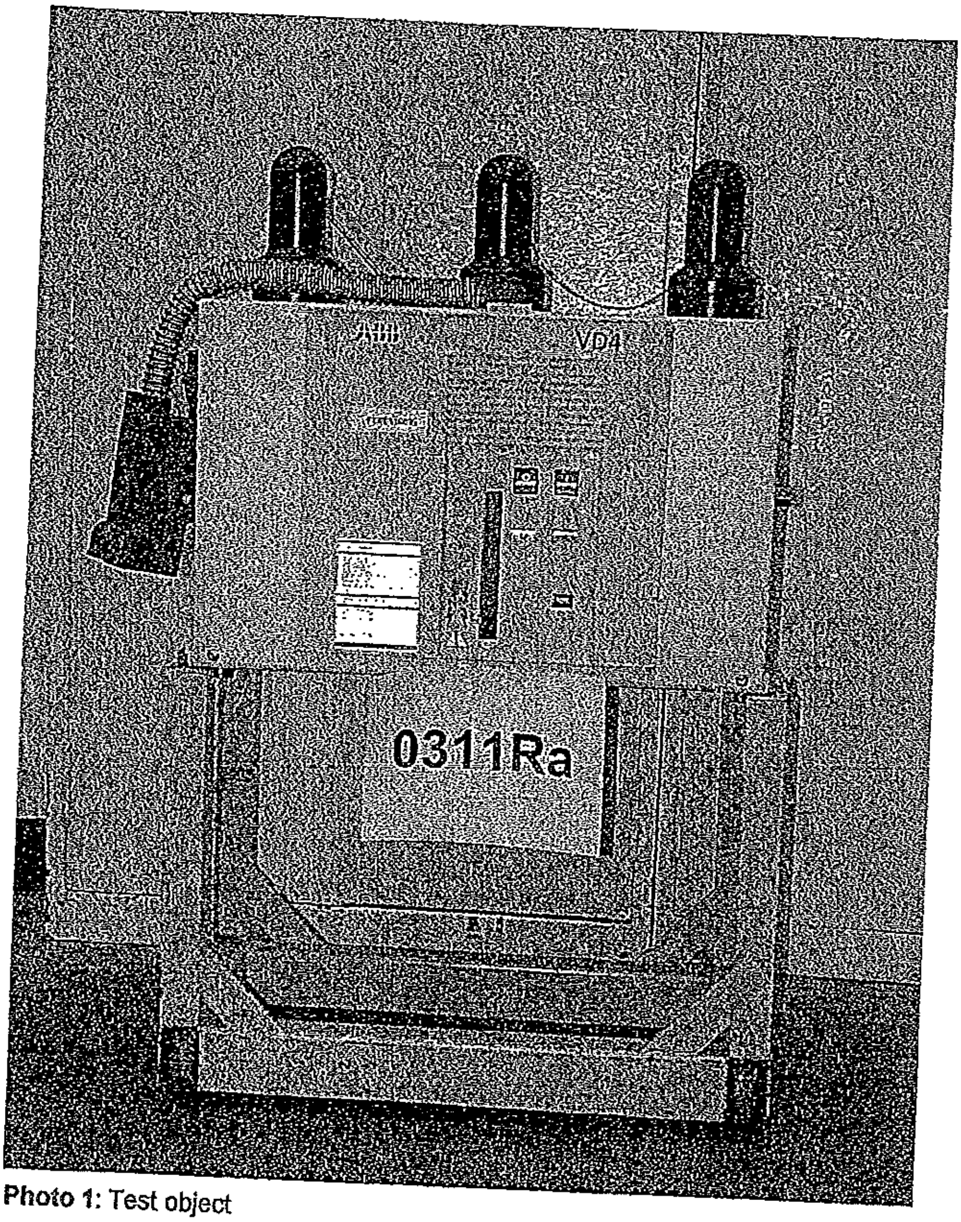


Photo 1: Test object

Deutscher Akkreditierungs Rat
DAR
Reg.-Nr.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 236 E 06

Sheet 1

Issued by an Accredited Laboratory
corresponding to EN 45001

Copy-No. 02e

Test Object

2-panel metal-clad air-insulated switchgear type ZS1.2 – 24 kV consisting of

- feeder panel 2000 A with vacuum circuit-breaker type VM1 2420-25, natural ventilated
- feeder panel 1250 A with vacuum circuit-breaker type VM1 2412-25

max. ambient temperature $\vartheta_{umax} = 40$ °C,

Rated voltage	U_n	24	kV
Rated normal current panel	I_n	2000 / 1250	A
Rated frequency	f	50	Hz
Rated short-time withstand current	I_{th}	25	kA
Rated peak withstand current	I_p	63	kA
Rated duration of short-circuit current	t_{th}	3	s
Rated short-circuit breaking capacity at 24 kV	I_{sc}	25	kA
Max. ambient temperature	ϑ_u	40	°C

Manufacturer

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

Tests performed

Three-phase temperature-rise test at the rated current of 2000 A / 1250 A at a power frequency of 50 Hz.
Measurement of the resistance of the main circuit before and after the temperature rise test.

Test Specification

IEC Standard 60694/2nd Ed./1996-5, clause 6.4 and 6.5
IEC Standard 60298/3rd Ed./1990-12, clause 6.3 and 6.4

Test Results

The 2-panel ZS1.2-type switchgear passed the above mentioned tests successsfully. The respective requirements are met. The test results are tabulated on sheets 19 to 24.

Test Date

November 11th - November 12th, 2000

Client

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

November 16th, 2000
Date of Issue

Laboratory Manager

Test Engineer

Total Number of Sheets: 29 Sheets (Test Report)

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory

Oberhausener Straße 33
D - 40472 Ratingen

Phone + 49 (0) 21 02 12-1905
Fax + 49 (0) 21 02 12-1713

ВЯРНО С ОРИГИНАЛА

Table of Contents

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Panel 1

Ratings assigned by the manufacturer

Test Object: Metal-clad air insulated switchgear, incoming panel with vacuum circuit-breaker type VM1
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.: 7550027/2016/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010459R0102

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current of busbar	2000	A
Rated normal current of tee-offs	2000	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Insulating medium	air / vacuum	
Rated functional pressure (abs. / 20°C)	-	kPa
Minimum functional pressure (abs. / 20°C)	-	kPa
Permissible values for internal arc faults:		
Peak current	63	kA
Short-time current	25	kA
Duration of short-circuit	1	s
Max. ambient air temperature	40	°C

The above mentioned switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current Transformers:

Manufacturer	**Type**	**Year of manufacture**	**Insulation class**
Wirges GmbH	TPU66.11	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
24/50/125 kV	50 Hz	25 kA / 3 s	63 kA
Serial Nos.	L1 058249, L2 058250; L3 058251		
Core 1	2000 / 5 A; 15 VA, accuracy class 0.5		
Core 2	2000 / 5 A; 15 VA, accuracy class 5P15		

Date of receipt of test object: 30th October 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Panel 2

Ratings assigned by the manufacturer

Test Object: Metal-clad air insulated switchgear, incoming panel with vacuum circuit-breaker type VM1
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.: 7550027/2014/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010457R0102

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current of busbar	2000	A
Rated normal current of tee-offs	1250	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Insulating medium	air / vacuum	
Rated functional pressure (abs. / 20°C)	-	kPa
Minimum functional pressure (abs. / 20°C)	-	kPa
Permissible values for internal arc faults:		
Peak current	63	kA
Short-time current	25	kA
Duration of short-circuit	1	s
Max. ambient air temperature	40	°C

The above mentioned switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current Transformers:

Manufacturer	**Type**	**Year of manufacture**	**Insulation class**
Wirges GmbH	TPU63.11	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
24/50/125 kV	50 Hz	25 kA / 3 s	63 kA
Serial Nos.	L1 058240, L2 058241; L3 058242		
Core 1	1250 / 5 A; 10 VA, accuracy class 0.5		
Core 2	1250 / 5 A; 10 VA, accuracy class 5P15		

Date of receipt of test object: 30th October 2000

Technical Data of Test Object

Switching Device – Circuit-Breaker of Panel 1

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VM1 2420-25
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.: 7550030/4006/00 **Year of manufacture:** 2000
Drawing No.: GCE7004924R0136 (circuit-breaker)
Vacuum interrupter: Type: VG4-S L1: No. 00/061190, L2: No. 00/061193, L3: No. 00/061195
Drawing No.: GCE7005757R0102 (pole part)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50 / 60	Hz
Rated normal current	2000	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	25	kA
D.C. component	40	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage:		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	35...45	ms
Rated closing time	50...60	ms
Rated voltage of trip coil	230	V
Rated voltage of closing coil	230	V
Rated supply voltage	230	V
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:

-

Date of receipt of test object: 30th October 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker of Panel 2

Ratings assigned by the manufacturer

Test Object:	Vacuum circuit-breaker
Type:	VM1 2412-25
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen; Germany
Serial-No.:	7550027/4004/00 **Year of manufacture:** 2000
Drawing No.:	GCE7004924R0121 (circuit-breaker)
Vacuum interrupter:	Type: VG4-S L1: No. 01936, L2: No. 00678, L3: No. 02130
Drawing No.:	GCE7004730R0102 (pole part)

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	50	kV
Rated frequency	50 / 60	Hz
Rated normal current	1250	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	25	kA
D.C. component	40	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage:		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	35...45	ms
Rated closing time	50...60	ms
Rated voltage of trip coil	230	V
Rated voltage of closing coil	230	V
Rated supply voltage	230	V
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:

-

Date of receipt of test object: 30th October 2000

ВЯРНО С ОРИГИНАЛА

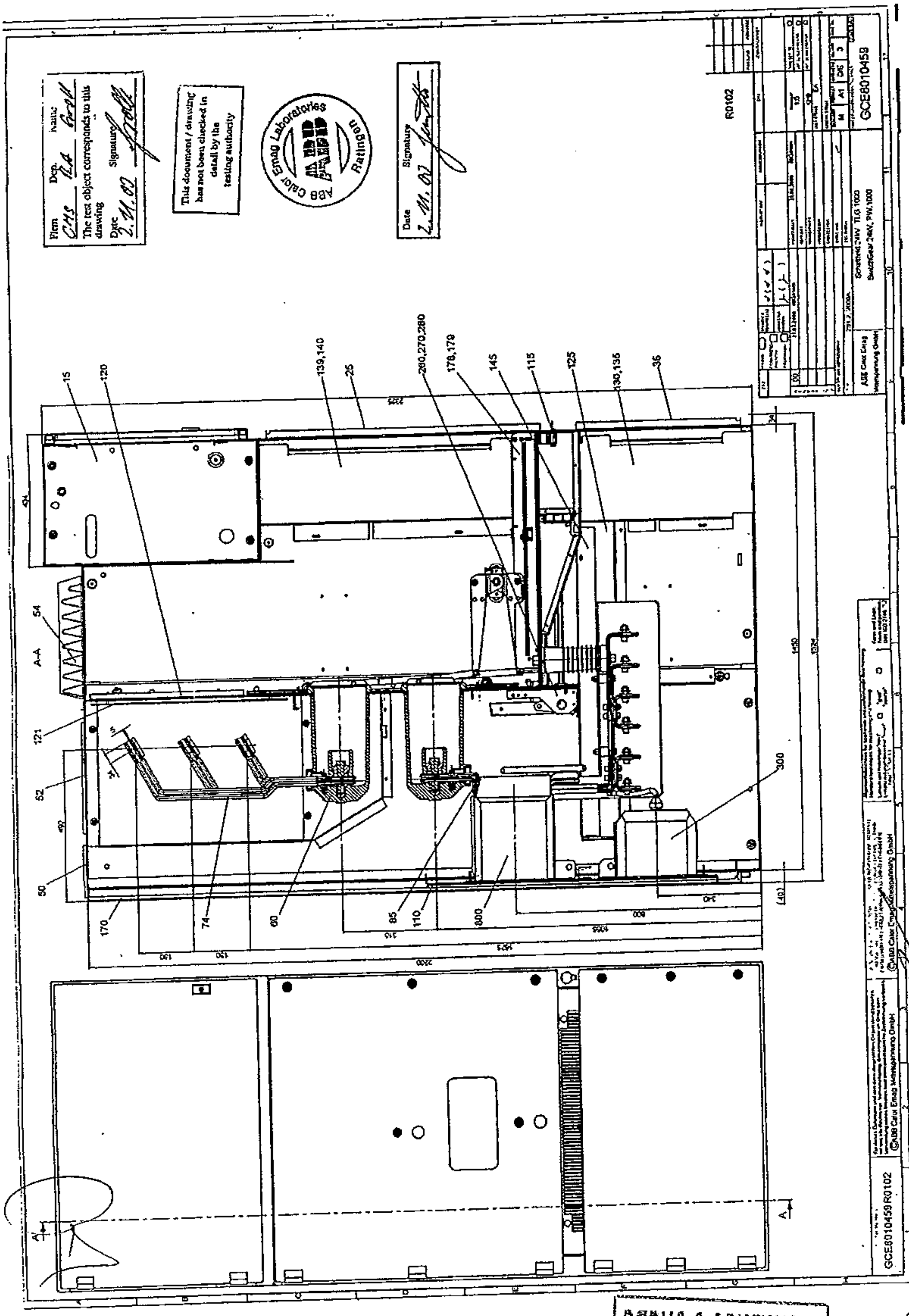
List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. These drawings have been stamped and signed by the manufacturer representative. The drawings has not been checked in detail by the testing authority. The drawings are kept

x with the test documents at the test laboratory.
at the client.

Drawing no.	Title
GCE8010459R0102 index 00	Switchgear, 24 kV, PW. 1000
GCE8010457R0102 index 00	Switchgear, 24 kV, PW. 800
GCE7004924R0136 index 00	Draw out VM1 24 kV in ZS1.2
GCE7004924R0121 index 06	Draw out VM1 24 kV in ZS1
GCE7005757R0102 index 00	Pole part VD4p 2420-25
GCE7004730R0102 index 09	pole part VD4 24 kV 1250 A

ВЯРНО С ОРИГИНАЛА



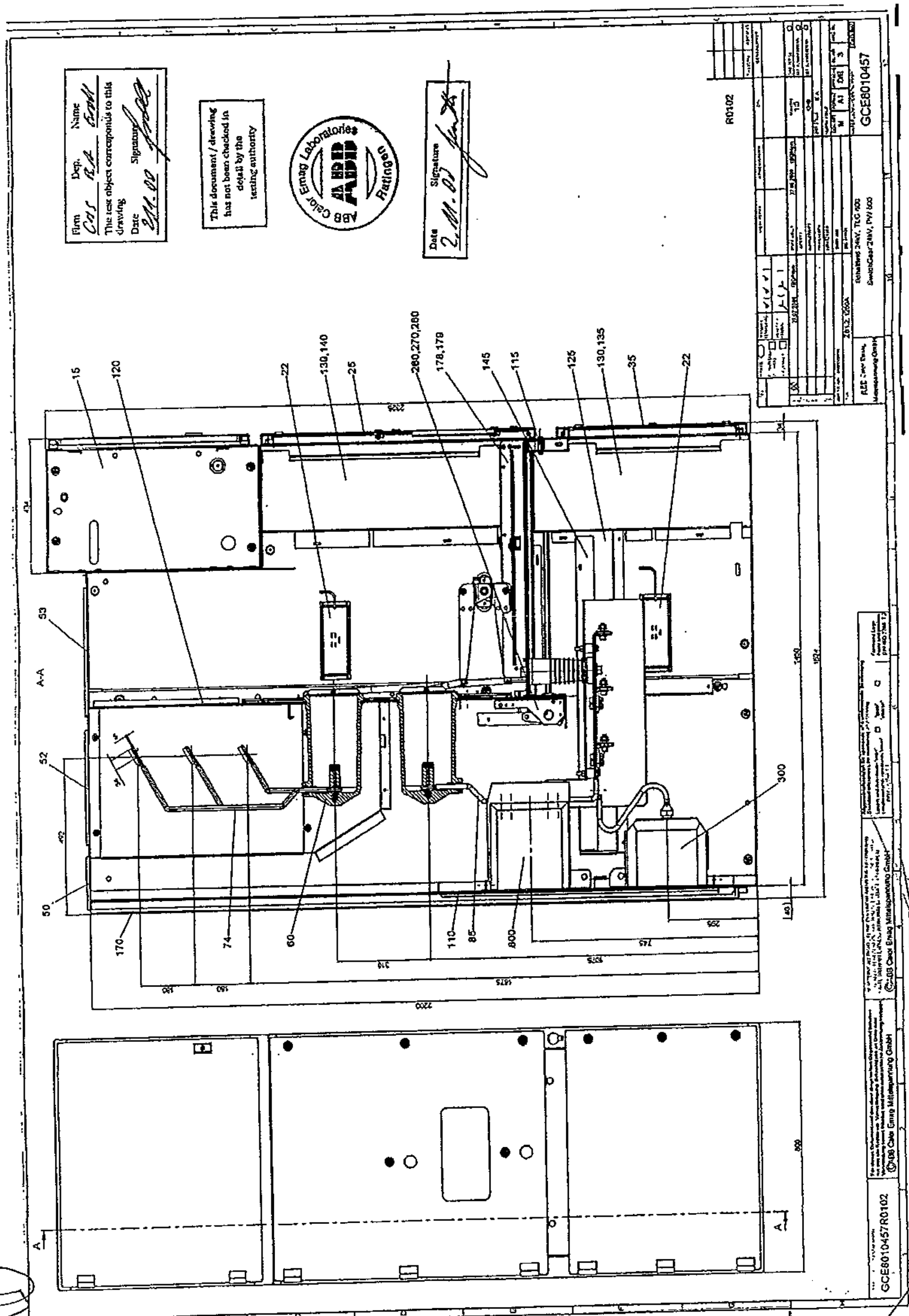
Item CHS Dep. TLA Name Groll
The test object corresponds to this drawing
Date 2.11.00 Signature

This document / drawing has not been checked in detail by the testing authority

ABB Calor Emag Laboratories Ratingen

Date 2.11.00 Signature

ВЯРНО С ОРИГИНАЛА



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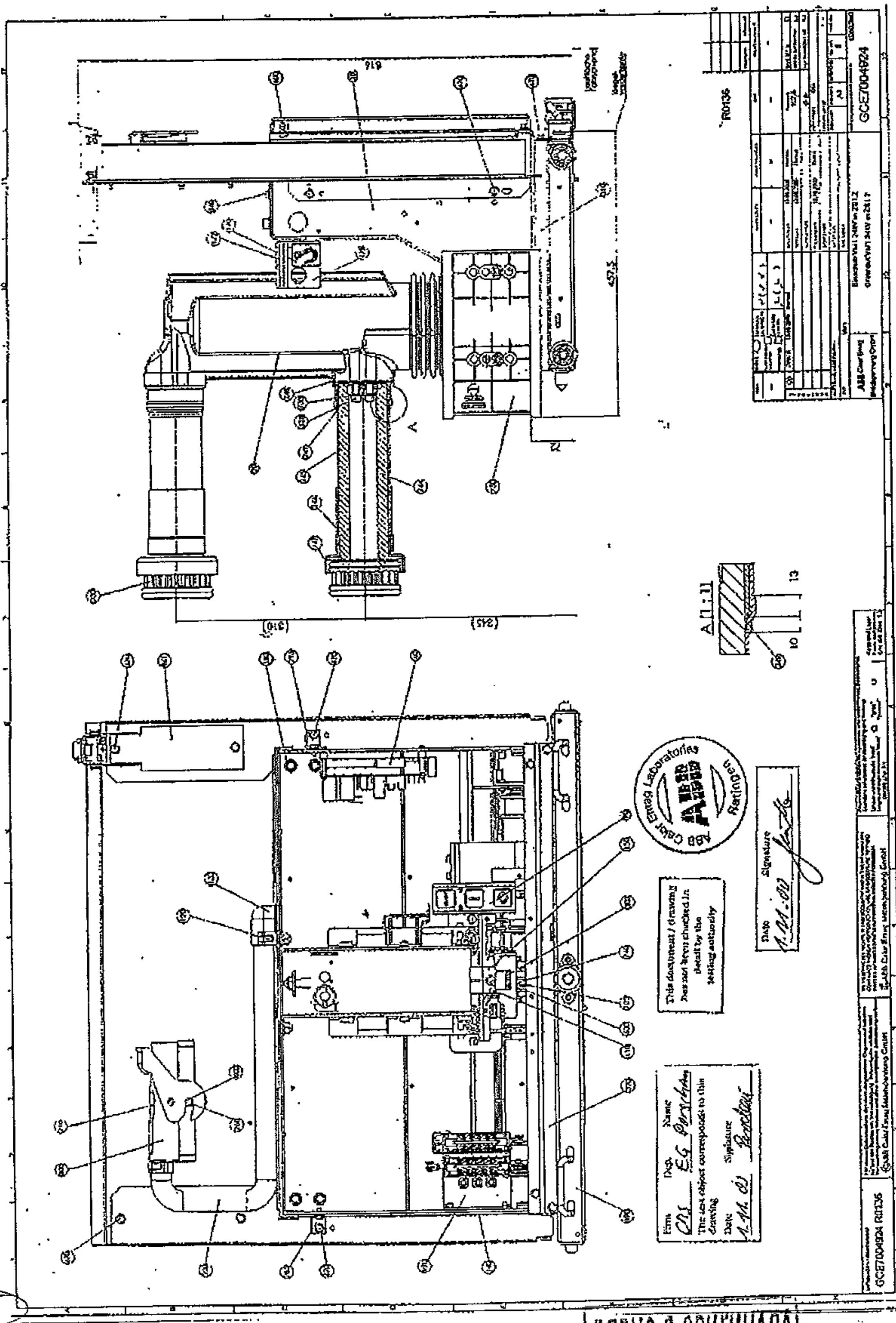
The test object corresponds to this drawing
Date 2.11.00 Signature

This document / drawing has not been checked in detail by the testing authority

ABB Calor Emag Laboratories Ratingen

Date 2.11.00 Signature

ВЯРНО С ОРИГИНАЛА



This document / drawing has not been checked in detail by the testing authority

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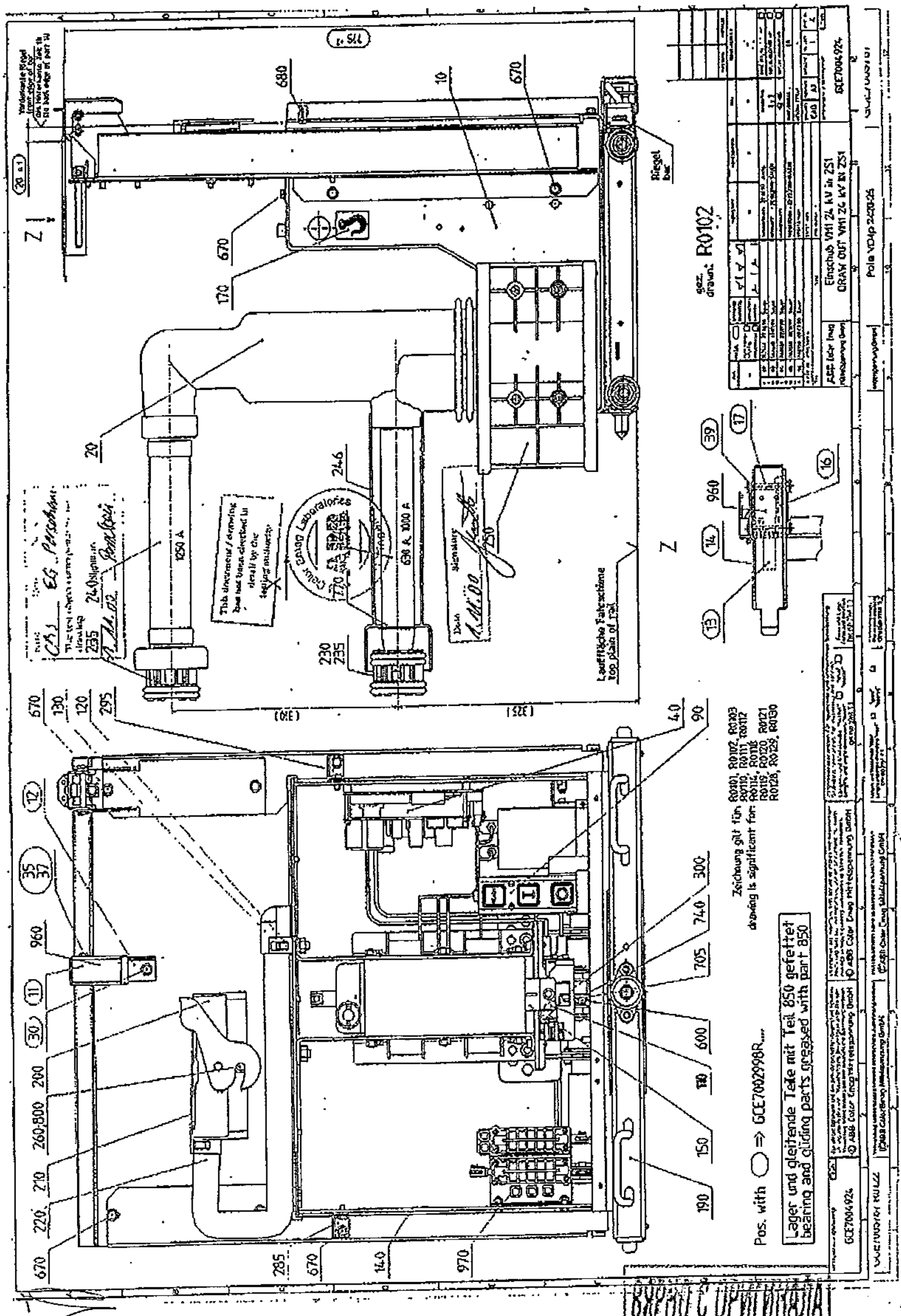
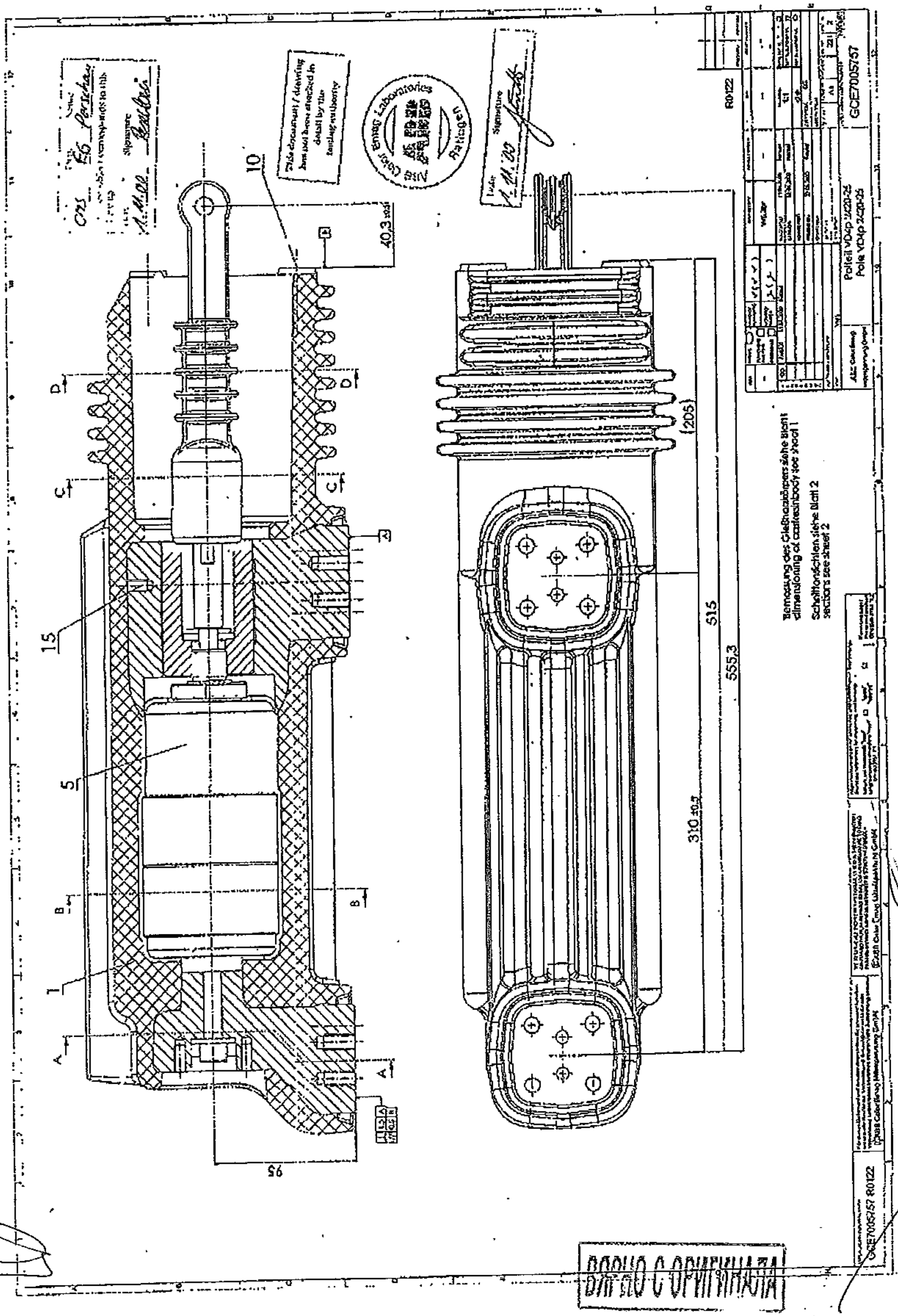
The test object corresponds to this drawing
Date 1.11.00 Signature

Date 1.11.00 Signature

ABB Calor Emag Laboratories Ratingen

ВЯРНО С ОРИГИНАЛА


Einschub VM1 24 kV in ZS1
DRAW OUT VM1 24 kV IN ZS1
GCE7004924
gez. drawn: R0102
ABB Calor Emag
Riegel bar
Z
Laufflächе Fahrschiene
top plain of rail
1250 A
630 A 1000 A
Zeichnung gilt für R0101, R0102, R0103, R0110, R0111, R0112, R0114, R0118, R0119, R0120, R0121, R0128, R0129, R0130
drawing is significant for
Lager und gleitende Teile mit Teil 850 gefettet
bearing and gliding parts greased with part 850
Pos. with ○ ⇒ GCE7002998R...
ABB Calor Emag Laboratories
10
20
170
246
250
670
680
230
235
120
130
295
40
90
300
740
705
600
150
190
12
35
37
960
11
30
200
260-800
210
220
285
140
970
13
14
16
17
39



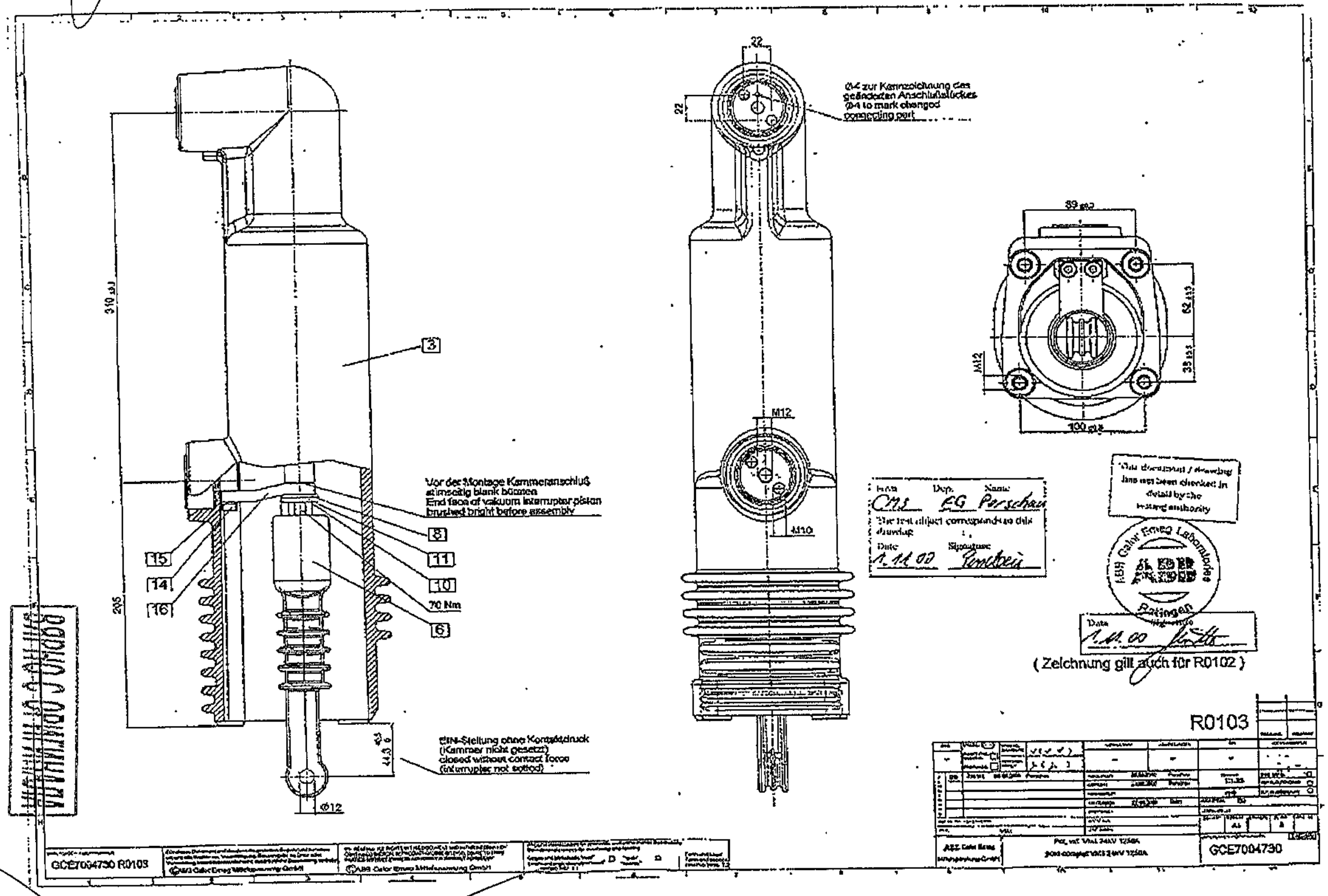
This document / drawing has not been checked in detail by the testing authority

ABB Calor Emag Laboratories Ratingen

Date 1.11.00 Signature

Date 1.11.00 Signature

ВЯРНО С ОРИГИНАЛА



Vor der Montage Kammeranschluß stirnseitig blank bürsten
End face of vakuum interrupter piston brushed bright before assembly

EIN-Stellung ohne Kontaktdruck (Kammer nicht gesetzt)
closed without contact force (interrupter not setted)

Ø4 zur Kennzeichnung des geänderten Anschlußstückes
Ø4 to mark changed connecting part

From: CMS Dep.: EG Name: Porschau
The test object corresponds to this drawing
Date: 1.11.00 Signature:

This document / drawing has not been checked in detail by the testing authority

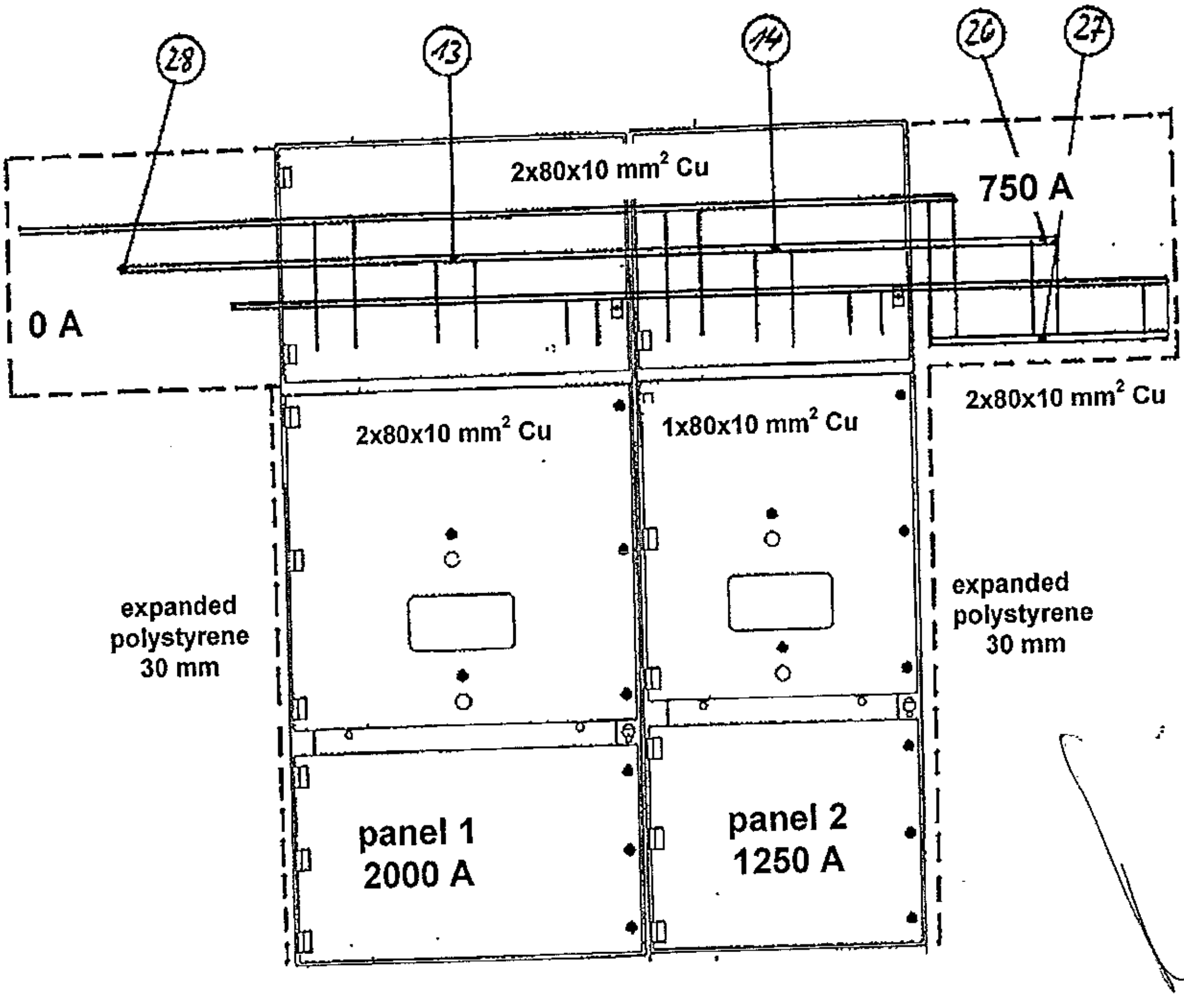
ABB Calor Emag Laboratories Ratingen

Date: 1.11.00

(Zeichnung gilt auch für R0102)

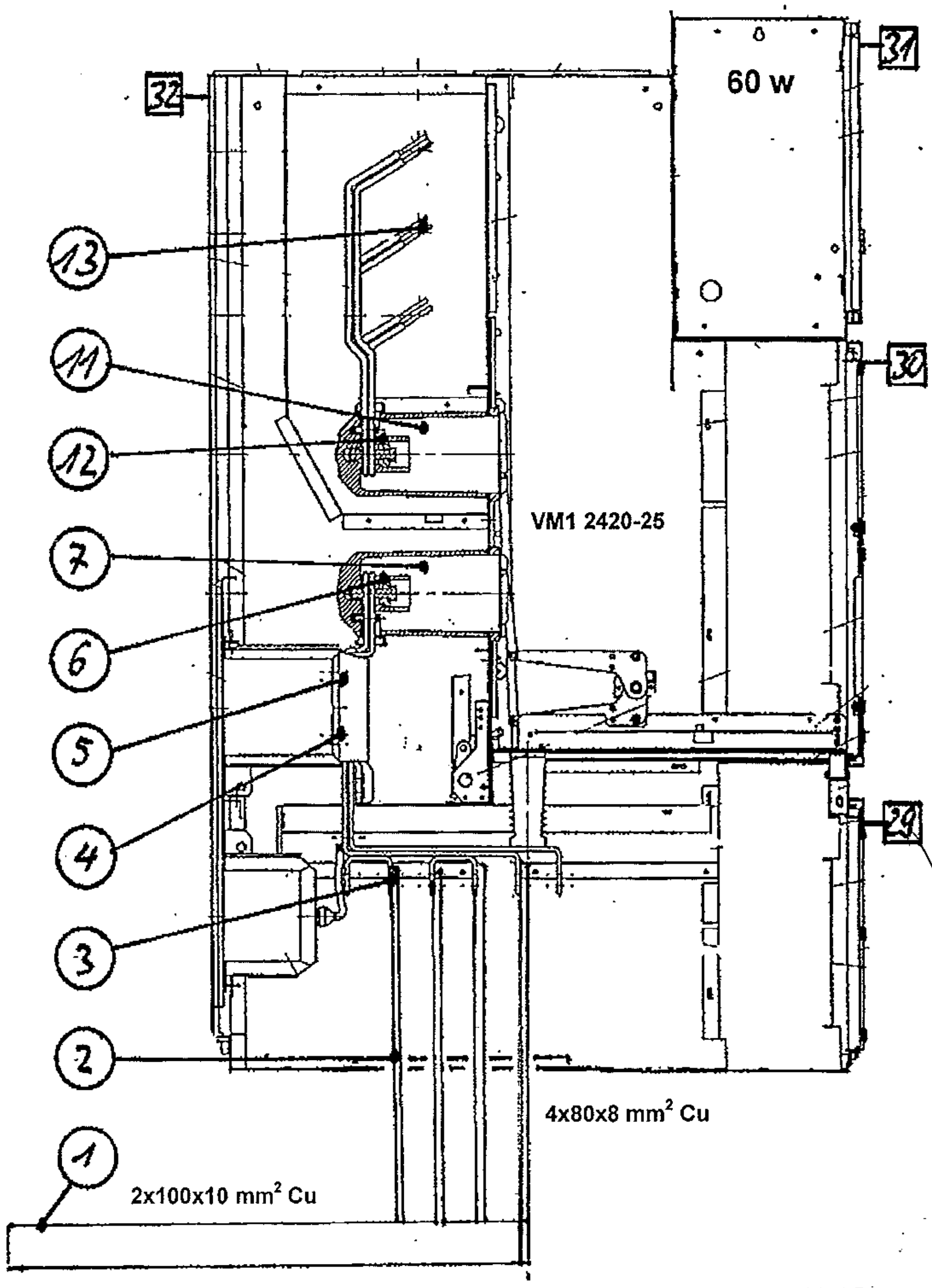
ВЯРНО С ОРИГИНАЛА

Test Arrangement and Measurement Points for Temperatures and Resistances on the Busbars



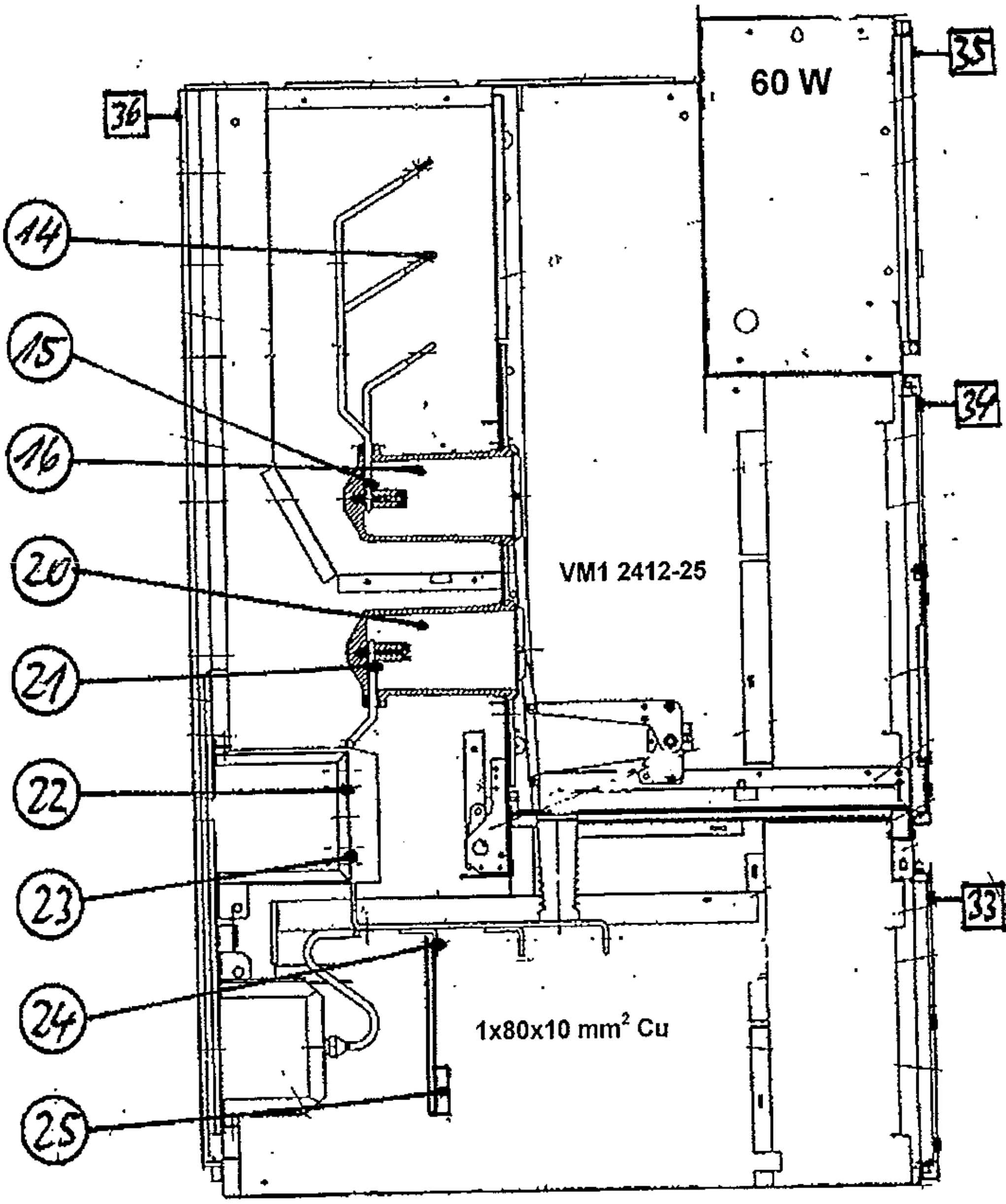
ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures and Resistances of Panel 1



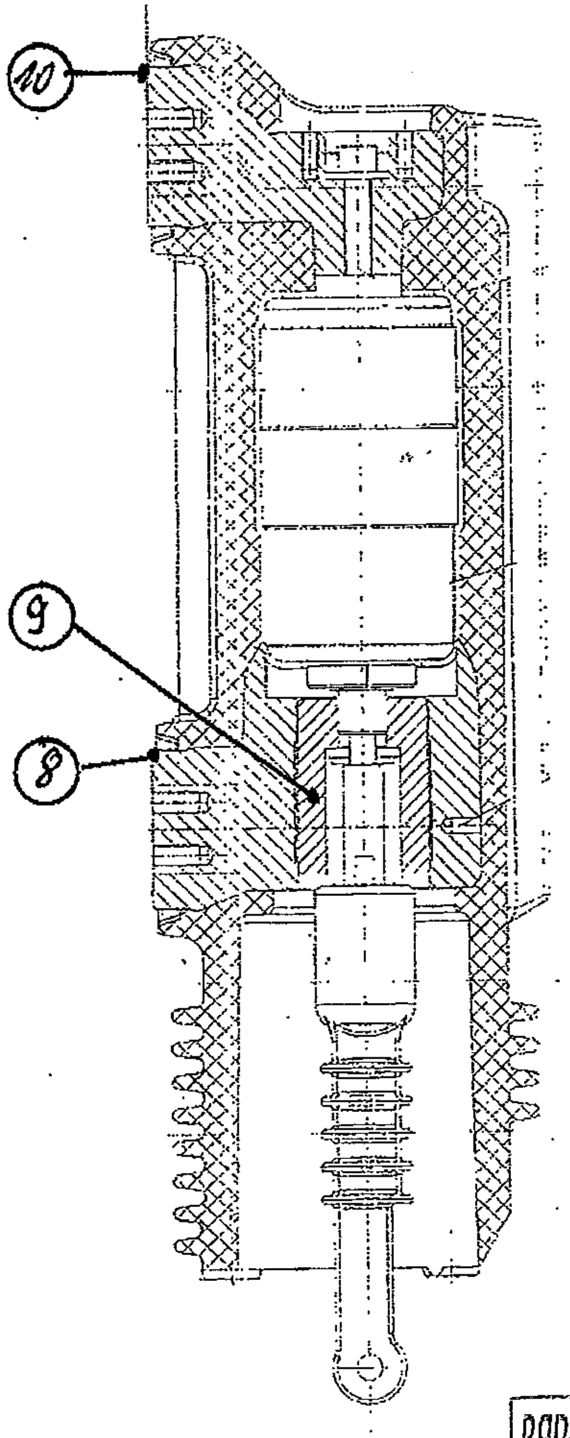
ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures and Resistances of Panel 2



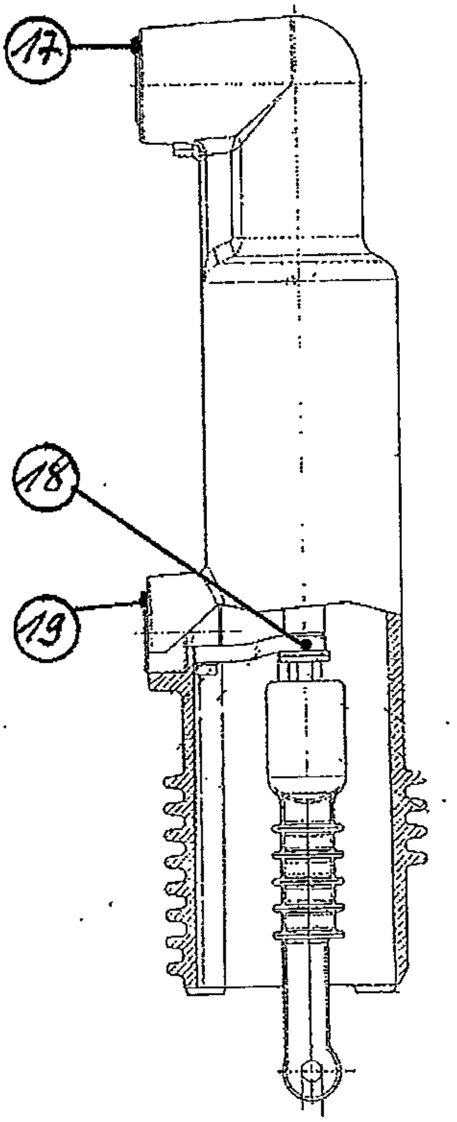
ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures of Circuit-Breaker Poles Panel 1



ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures of Circuit-Breaker Poles Panel 2



ВЯРНО С ОРИГИНАЛА

Measurement of the Resistance of the Main Circuit

Date of test: 11th November 2000 - before temperature rise test
12th November 2000 - after temperature rise test

Condition of test object before test: factory new panels

Ambient air temperature: before temperature rise test 22 °C
after temperature rise test 24 °C

Measurement between points (see sheet 14 - 16)	Resistance of the main circuit μΩ		
	L1 before/after1)	L2 before/after1)	L3 before/after1)
2 - 14 (panel 1)	56.3 / 56.4	53.5 / 53.6	51.6 / 51.5
13 - 25 (panel 2)	95.0 / 94.4	90.4 / 89.1	83.3 / 81.9

Remarks: 1) Before: before temperature rise test
After: after temperature rise test

Resistance measurement at direct current of: 50 A

The measurement of the resistances are carried out by using the thermocouples at the named measurement points.

ВЯРНО С ОРИГИНАЛА

Temperature Rise Test

Date of test: 11th and 12th November 2000

Condition of test object before test: factory new panels

Connections to test object: feeder:

two bars 100x10 mm^2 Cu, length about 2 m outside the panel and four bars 80x8 mm^2 Cu, length about 0.8 m outside and inside the panel

neutral points:

1. busbar outside feeder panel 2 with two bars 80x10 mm^2 Cu
2. extended cable connection bars of panel 2 with one bar 80x10 mm^2 Cu

Duration of test: 9 **h**
Ambient air temperature: 26.1 **°C**
Test current: see sheet 14
Test frequency 50 **Hz**

Distribution of the currents of the panels:

panel or busbar	current in A			
	phase L1	phase L2	phase L3	average value
panel 1, incoming 2000 A	2002	2004	2013	2006
busbar panel 1 - 2	2002	2004	2013	2006
panel 2, outgoing 1250 A	1251	1250	1252	1251

Remarks:

1. The distribution of the currents at the busbar connections of the feeder panel 2 was done by using of iron cores over the extended busbars.
2. The side walls of the panels and the extended busbars were covered by expanded polystyrene sheets of 30 mm thickness.
3. The temperatures were measured by thermocouples type T. For the measurement points of the main circuit the thermocouples were inserted into holes and fixed. The measurement system determines the average value of the ambient temperatures, calculates the differences to the temperatures of all measuring points and records the temperature rises directly.

ВЯРНО С ОРИГИНАЛА

Permitted Temperature Rise of the Main Circuit

according IEC 60694 table 3

Kind of measuring point	Maximum value temperature rise at ambient air temperature not exceeding 40 °C	Measuring point (see sheet 14 to 18)
cable terminal	50	3, 24
Connection, bolted, Cu silver coated in air	75	13, 14, 18, 26, 27,28
Connection, bolted, Cu silver coated in air in contact with insulation material class A	65	8, 10, 17, 19
Connection, bolted, Cu silver coated in air in contact with insulation material class E	75	4, 5, 22, 23
Contact, Cu silver-coated in air	65	6, 7, 9, 11, 12, 15, 16, 20, 21

Continuation from sheet 20

Measuring point (see sheets 15 and 16)	Panel	Description of measuring point	Kind of measuring point	Final temperature rise K	Permitted temperature rise K
29	1	Front door top cable compartment	Access. part expected to be touched in normal operation	4.7	30
30	1	Front door top c.b. compartment	Access. part expected to be touched in normal operation	5.0	30
31	1	Front door top low voltage compartment	Access. part expected to be touched in normal operation	7.6	30
32	1	Rear wall top	Accessible part which need not to be touched in normal op.	14.4	40
33	2	Front door top cable compartment	Access. part expected to be touched in normal operation	3.8	30
34	2	Front door top c.b. compartment	Access. part expected to be touched in normal operation	6.3	30
35	2	Front door top low voltage compartment	Access. part expected to be touched in normal operation	8.1	30
36	2	Rear wall top	Accessible part which need not to be touched in normal op.	11.0	40

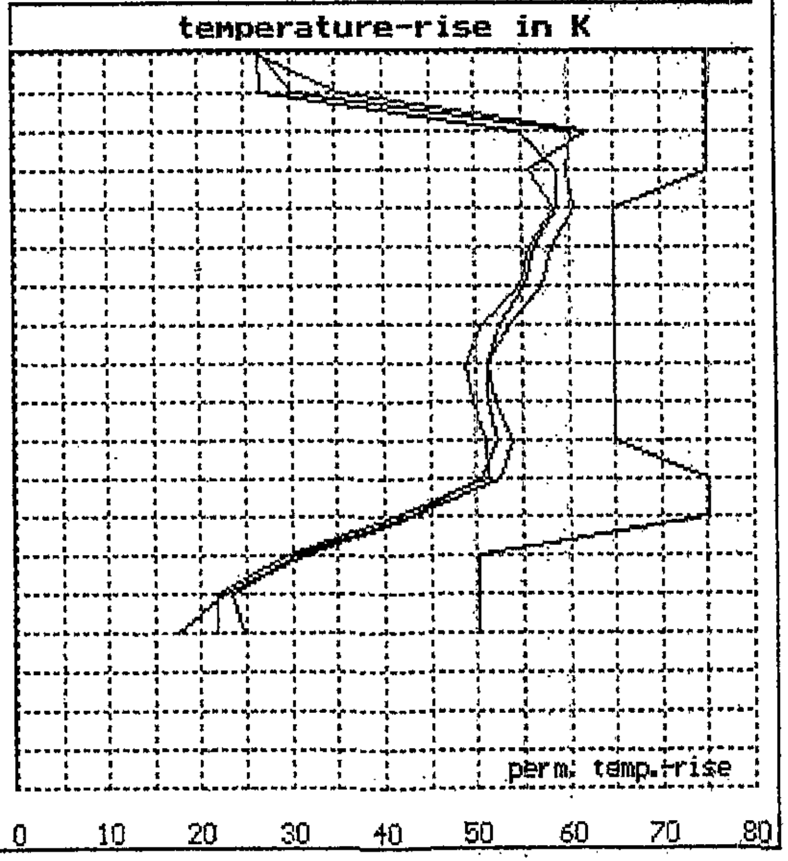
Temperature rises and Permitted Temperature rises of the Incoming Panel 1 and the Busbar – right side

ABB Calor Emag Laboratory Test report HZ236E06 **12.11.2000**

Temperature-rise of switchgear ZS1.2 - 24 kV with VM1 2420-25 with VG4-S

No.	Measuring points Name	Temperature-rise Δδ / K P1	P2	P3
27	neutral point busbar	26.3	26.9	26.6
26	end of busbar panel 2	35.5	30.2	26.8
14	busbar/jumper bar panel 2	61.9	60.4	54.6
13	jumper bar/busbar panel 1	55.7	59.7	58.7
12	upper disconn. contact pan	58.4	60.6	58.8
11	upper disconn. cont. c.b.	55.7	58.3	56.3
10	upper pole terminal	54.8	57.2	55.1
9	sliding contact stem side	50.7	53.5	52.6
8	lower pole terminal	48.9	51.2	51.3
7	lower disconn. cont. c.b.	49.7	52.0	51.2
6	lower disconn. contact pan	51.0	53.9	52.2
5	upper c.t. terminal	51.2	52.6	50.3
4	lower c.t. terminal	40.9	43.0	42.5
3	cable terminal	29.6	31.4	30.2
2	cable bar inside panel 1	21.8	22.6	23.3
1	feeder bar 1 m before 2	21.6	17.3	24.7

Test current : 2006 A
Ambient temperature : 26.1 °C



ВЯРНО С ОРИГИНАЛА

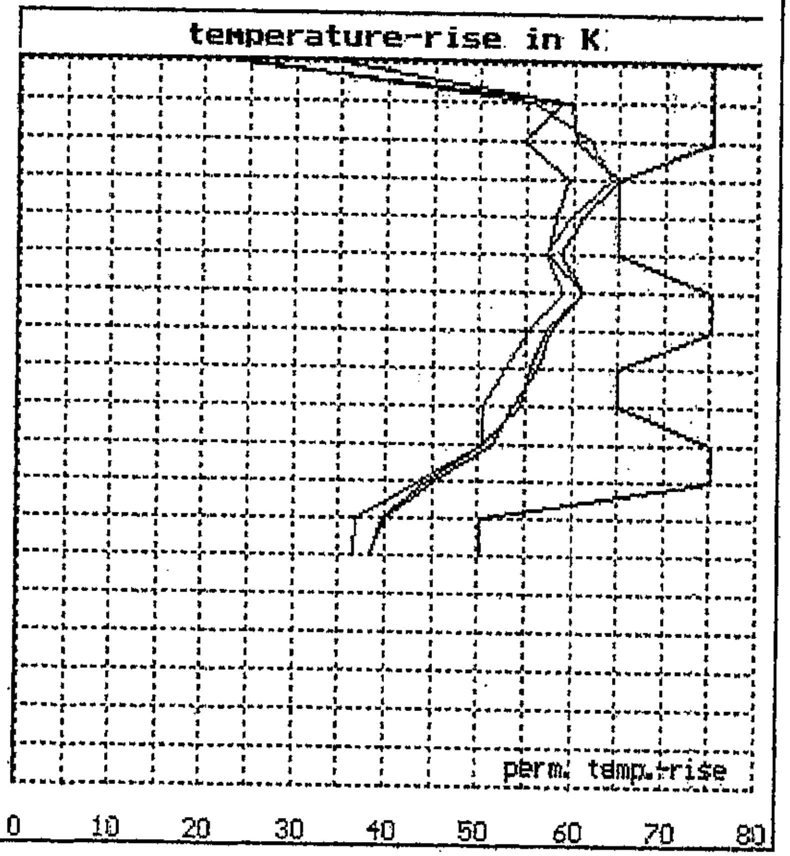
Temperature rises and Permitted Temperature rises of the Feeder Panel 2 and the Busbar – left side

ABB Calor Emag Laboratory Test report HZ236E06 **12.11.2000**

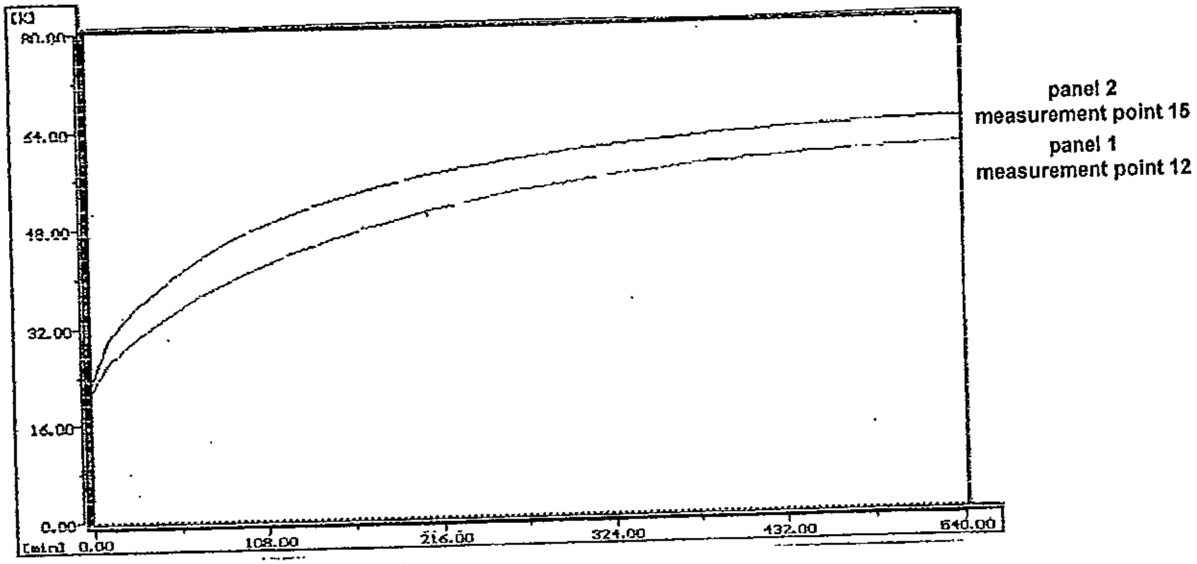
Temperature-rise of switchgear ZS1.2 - 24 kV with VM1 2406-25 with VG4-S

Test current : 1251 A
Ambient temperature : 26.1 °C

No.	Measuring points Name	Temperature rise Δϑ / K P1	P2	P3
28	end of busbar panel 1	24.9	23.3	34.9
13	busbar/jumper bar panel 1	55.7	59.7	58.7
14	busbar/jumper bar panel 2	61.9	60.4	54.6
15	upper disconn. contact pan	64.1	64.9	59.6
16	upper disconn. cont. c.b.	59.8	61.2	58.1
17	upper pole terminal	57.0	58.7	57.3
18	current lead interr. stem	59.0	61.1	61.2
19	lower pole terminal	55.2	57.7	57.1
20	lower disconn. cont. c.b.	52.9	56.3	55.5
21	lower disconn. cntact pan	50.4	53.5	54.4
22	upper c.t. terminal	50.3	51.6	50.4
23	lower c.t. terminal	43.7	45.4	44.5
24	cable terminal	36.7	40.0	39.7
25	neutral point cable term.	36.5	38.3	38.3



Temperature rise of upper Disconnecting Contacts Panel Side - Phase L2



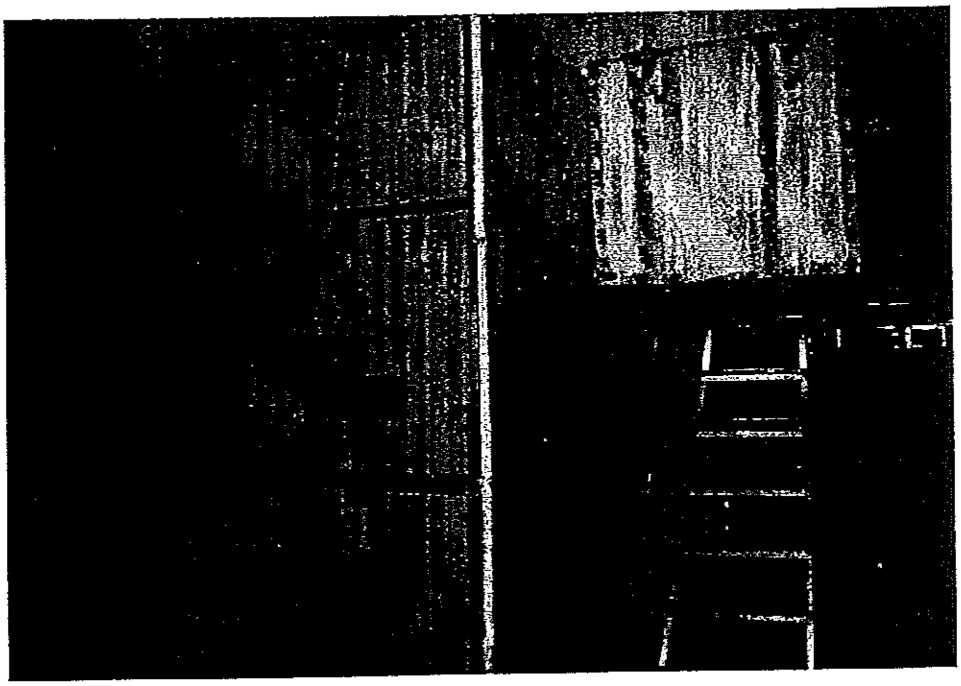


Photo 1: front view left

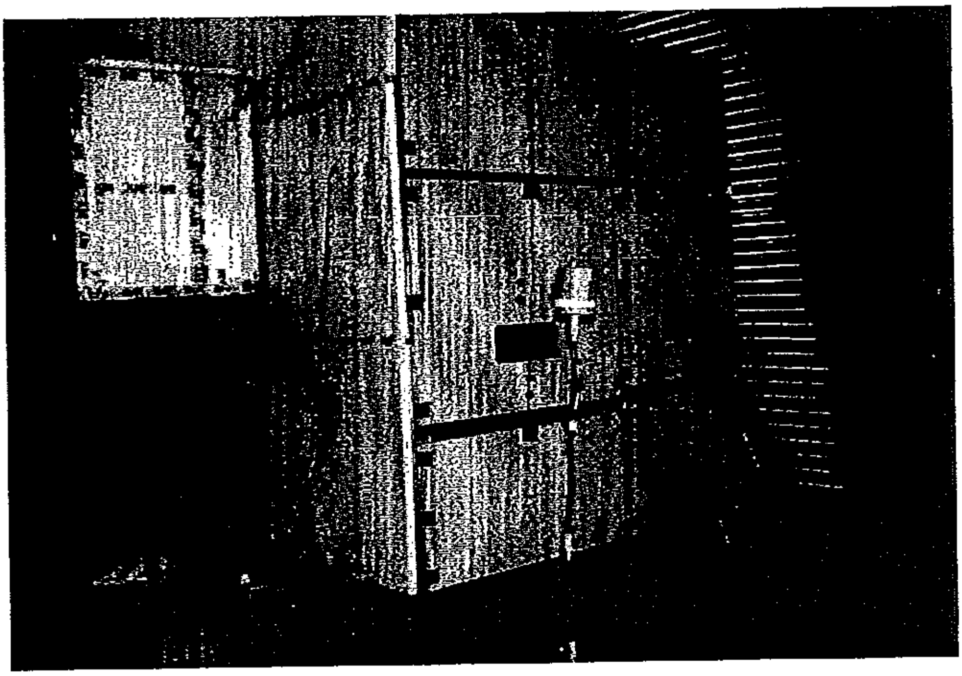


Photo 2: front view right

ВЯРНО С ОРИГИНАЛА

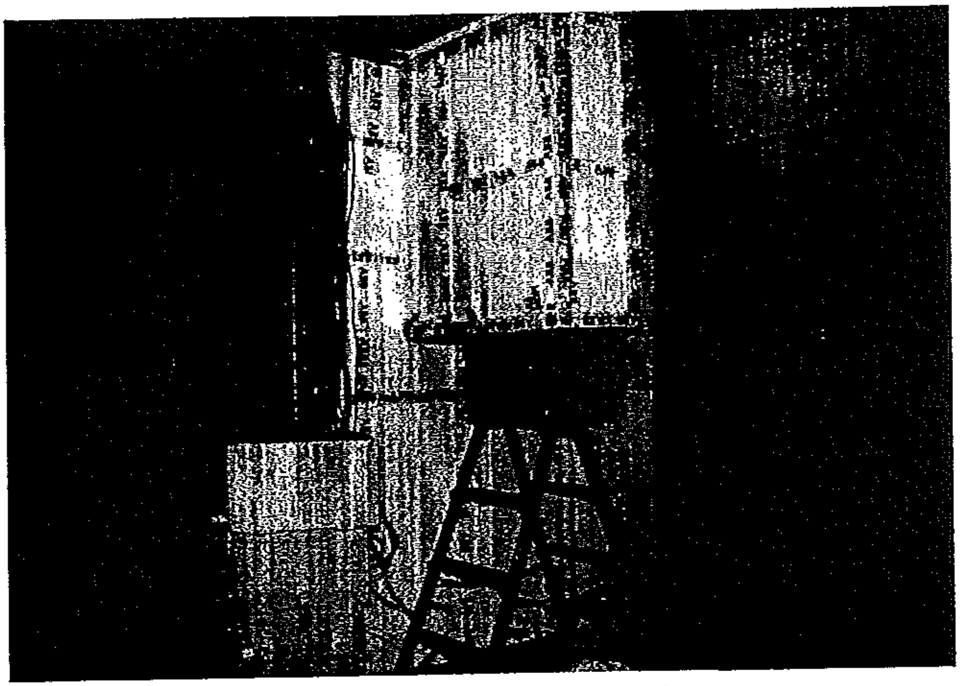


Photo 3: side view left

Photo 4: rear view

ВЯРНО С ОРИГИНАЛА

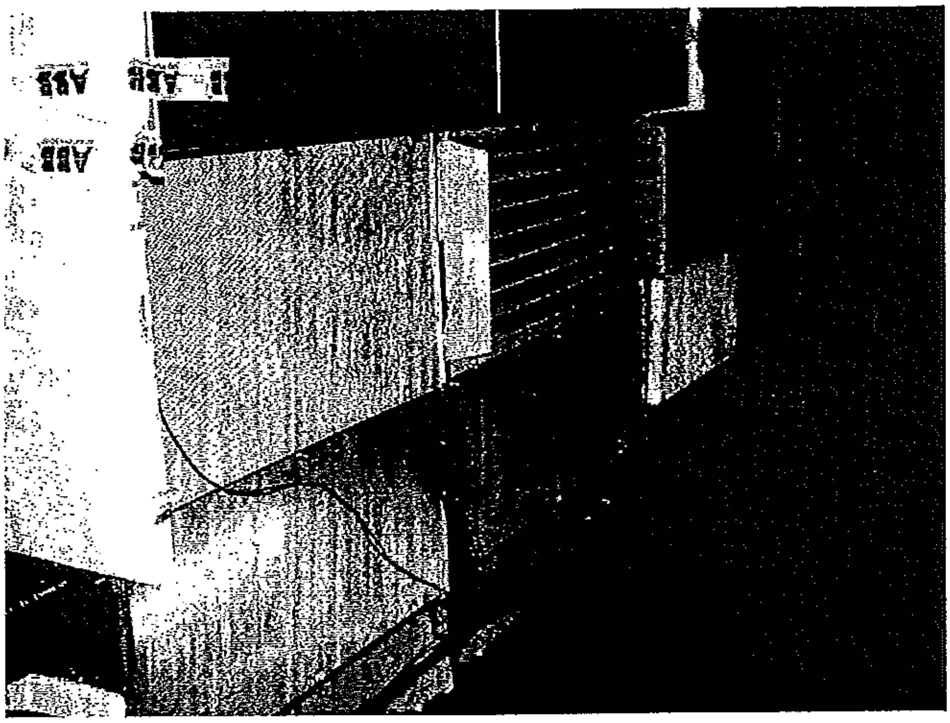


Photo 5: top view

ВЯРНО С ОРИГИНАЛА

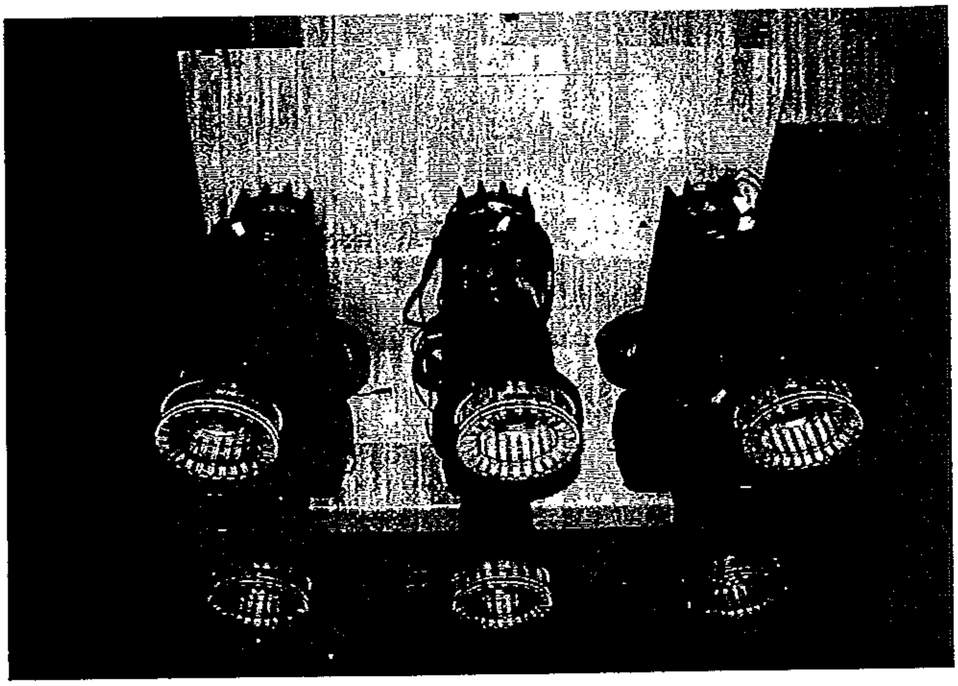


Photo 6: VM1 2420-25

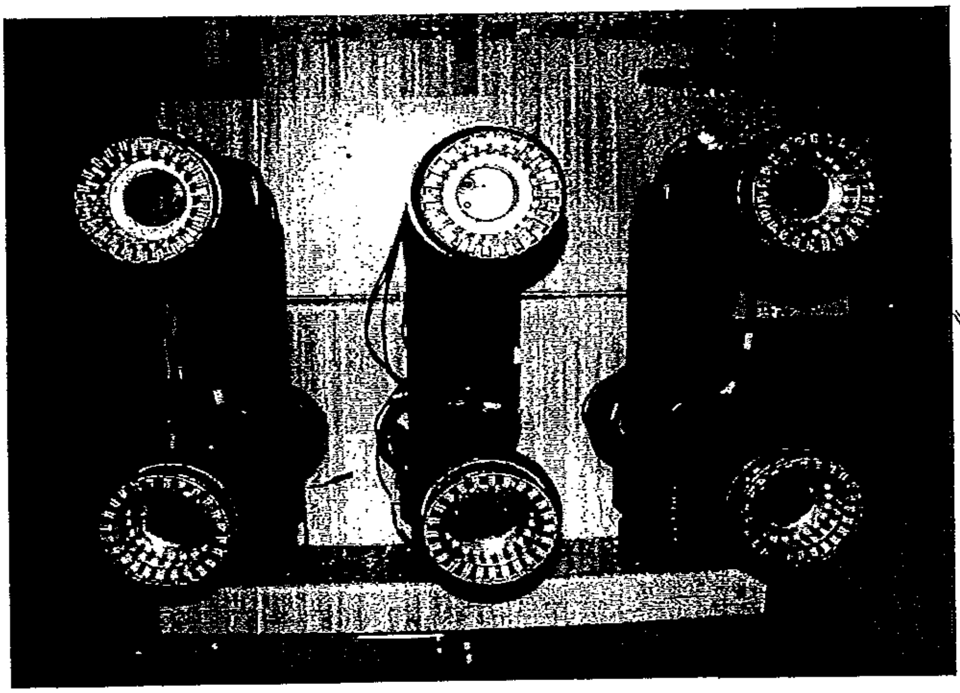


Photo 7: VM1 2420-25

ВЯРНО С ОРИГИНАЛА

Photo 8: VM1 2412-25

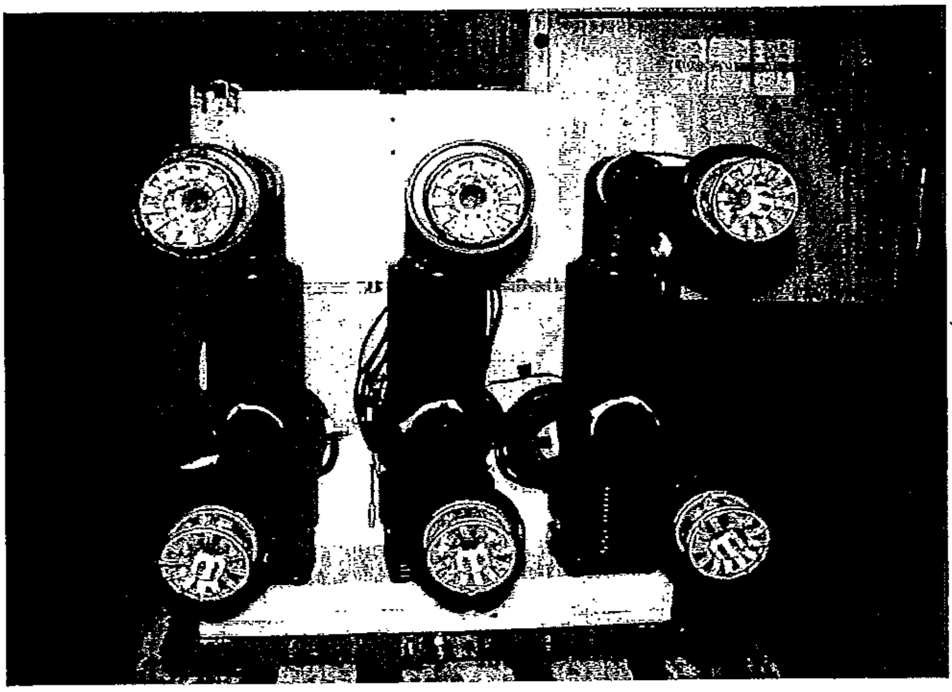


Photo 9: VM1 2412-25

ВЯРНО С ОРИГИНАЛА

АББ Трансмисионе & Дистрибузионе С.п.А.
Унита Оперaтива Саче Т.М.С.

Виа Фриули 4
I 24044 – Далмине (BG)
Италия

тел.: 0039.035.395111
факс: 0039.035.395874
E – mail: sacetms.tipm@it.abb.com
интернет: //www.abb.com

ПРОТОКОЛ ЗА ТИПОВИ ИЗПИТАНИЯ No. 100089_C СТРАНЦИ 1/1

Apparatus: КРУ тип ZS1 изд. 1.2 с вакуумнен прекъсвач тип VD4/P 24.12.20 p=275

Идентификация: 1VCP0000138-Rev.-,en-Технчиески каталог-2003-04

Параметри:			
	Номинално напрежение:	24	kV
	Ном. Издържано импулсно напрежение:	125	kV
	Ном. Издържано напрежение с 50Hz:	75	kV
	Номинална честота:	50-60	Hz
	Номинален ток на шината:	1250	A
	Номинален ток на ошиновката:	1250	A
	Ном. Издържан ток, пикова стойност:	63	kA
	Ном. Издържан кратковременен ток на к.с.:	20	kA
	Ном. Продължителност на к.с.:	3	s

Test reports verifying rating assigned by the manufacturer:

Изпитания	Тест съгласно стандарт	Тестов протокол	
		No.	Издаден от
Диелектричени изпитания	IEC 60298 Subclausole 6.1	0045 Ra	ПЕХЛА Високо-мощностни лаборатории
Тест с повишаване на температурата	IEC 60298 Subclausole 6.3/6.4	HZ 236 E06	АББ Калор Емаг Лаборатирии
Тест за кратковременен т.к.с. и пиков т.к.с.	IEC 60298 Subclausole 6.5	HZ 235 F01	АББ Калор Емаг Лаборатирии в лаборатория CESI Лаб.
Механична работа и тест за блокировки	IEC 60298 Subclausole 6.102	MZ 235 A01	АББ Калор Емаг Лаборатирии
Тест за вътрешна дъга	IEC 60298 Annex AA	HZ 235 L02	АББ Калор Емаг Лаборатирии
Тест за механична работа	IEC 62271-100 subclause 6.101.2	0311 Ra	ПЕХЛА Високо-мощностни лаборатории
Тест за способност за изкл. на т.к.с. и вкл. върху т.к.с.	IEC 62271-100 subclause 6.106	0511 Ra	ПЕХЛА Високо-мощностни лаборатории

Лабораторията на АВВ ТиД Унита Оперaтива САЧЕ Т.М.С. в гр. Далмине е акредитирана съгласно UNI CEI EN ISO/IEC 17025 от SINAL с регистрационен номер Reg. No. 0253

Лабораторията на АББ Калор Емаг в гр. Ратинген, Германия е акредитирана съгласно UNI CEI EN ISO/IEC 17025 от DATech под регистрационен номер No. DAT-P-032/93

Високо-мощностните лаборатории ПЕХЛА са акредитирани съгласно UNI CEI EN ISO/IEC 17025 от DATech с регистрационен номер No. DAT-P-032/93 и сертификат Д-ПЛ-12072-06-01

ЧЕЗИ Лаборатории Милано са акредитирани съгласно UNI CEI EN ISO/IEC 17025 от SINAL с регистрационен номер Reg. No. 0030

Дата на издаване:
04/09/16

Отдел за Развойна дейност

Г.М. Граванзола

ВЯРНО С ОРИГИНАЛА

ABB T&D Unità operativa Sace T.M.S. is accreditated by DET NORSKE VERITAS QUALITY CERTIFICATE Quacer Certificate No. CERT-07978-2001-AQ-MIL-SINCERT/B according to ISO 9001.

Приложение 1.3 - Акредитация

ВЯРНО С ОРИГИНАЛА

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

ilac-MRA

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n° / *Accreditation n°* **0253** Rev. **1**

Si dichiara che / *We declare that*

ABB S.p.A. Power Products Division
Sede/Headquarters:
Via Friuli 4 - 24044 Dalmine BG

è conforme ai requisiti della norma: UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura"

meets the requirements of the standard: EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard

quale **Laboratorio di Prova**

as ***Testing Laboratory***

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

Data di 1ª emissione *1st issue date* **1999-07-08**	Data di modifica *Modification date* **2015-07-16**	Data di scadenza *Expiring date* **2019-07-11**
Il Direttore Generale *The General Director* (Dr. Filippo Trifiletti)	Il Direttore di Dipartimento *Department Director* (Dr.ssa Silvia Tramontin)	Il Presidente *The President* (Ing. Giuseppe Rossi)

ВЯРНО С ОРИГИНАЛА

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

ВЯРНО С ОРИГИНАЛА

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

Office Berlin Spittelmarkt 10 10117 Berlin	Office Frankfurt am Main Gartenstraße 6 60594 Frankfurt am Main	Office Braunschweig Bundesallee 100 38116 Braunschweig

The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

ВЯРНО С ОРИГИНАЛА

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

ilac-MRA

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n° *Accreditation n°*	**0030**	Rev. **2**
Si dichiara che *We declare that*	**CESI S.p.A.** Sede/Headquarters: Via Rubattino 54 - 20134 Milano MI	
è conforme ai requisiti della norma	UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura"	
meets the requirements of the standard	*EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard*	
quale	**Laboratorio di Prova**	
as	***Testing Laboratory***	

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

Data di 1ª emissione *1st issue date* **1992-02-27**	Data di modifica *Modification date* **2016-04-14**	Data di scadenza *Expiring date* **2020-03-09**
Il Direttore Generale *The General Director* (Dr. Filippo Trifiletti)	Il Direttore di Dipartimento *Department Director* (Dr.ssa Silvia Tramontin)	Il Presidente *The President* (Ing. Giuseppe Rossi)

ВЯРНО С ОРИГИНАЛА

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n°
Accreditation n° **0030** Rev. **2**

Si dichiara che
We declare that

Sedi operative:

CESI S.p.A.
Via Rubattino 54
20134 Milano MI
CESI S.p.A. - Sede di Piacenza
Via Nino Bixio 39
29100 Piacenza PC
CESI S.p.A. - Sede di Seriate
Via Pastrengo 9
24068 Seriate BG

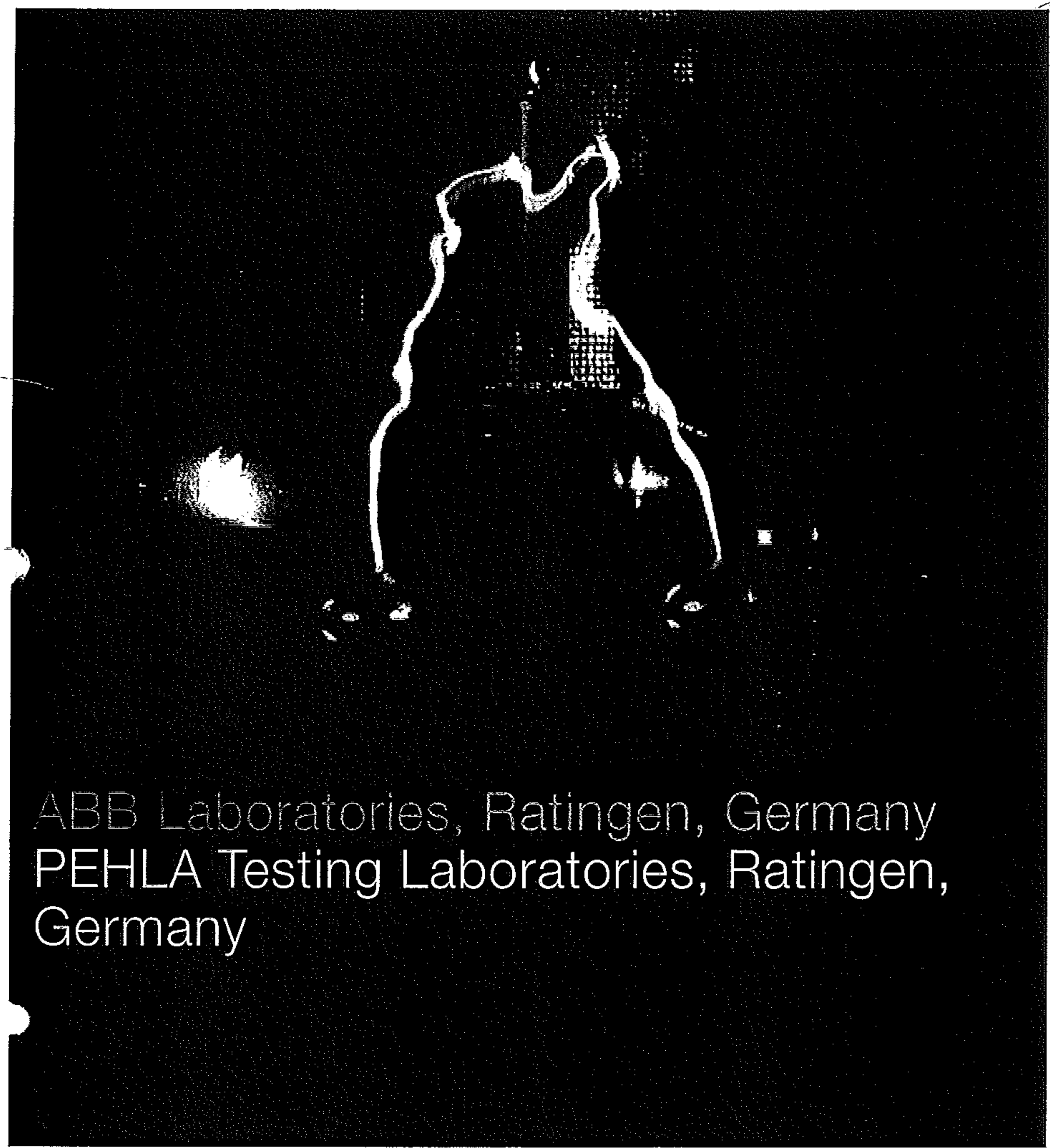
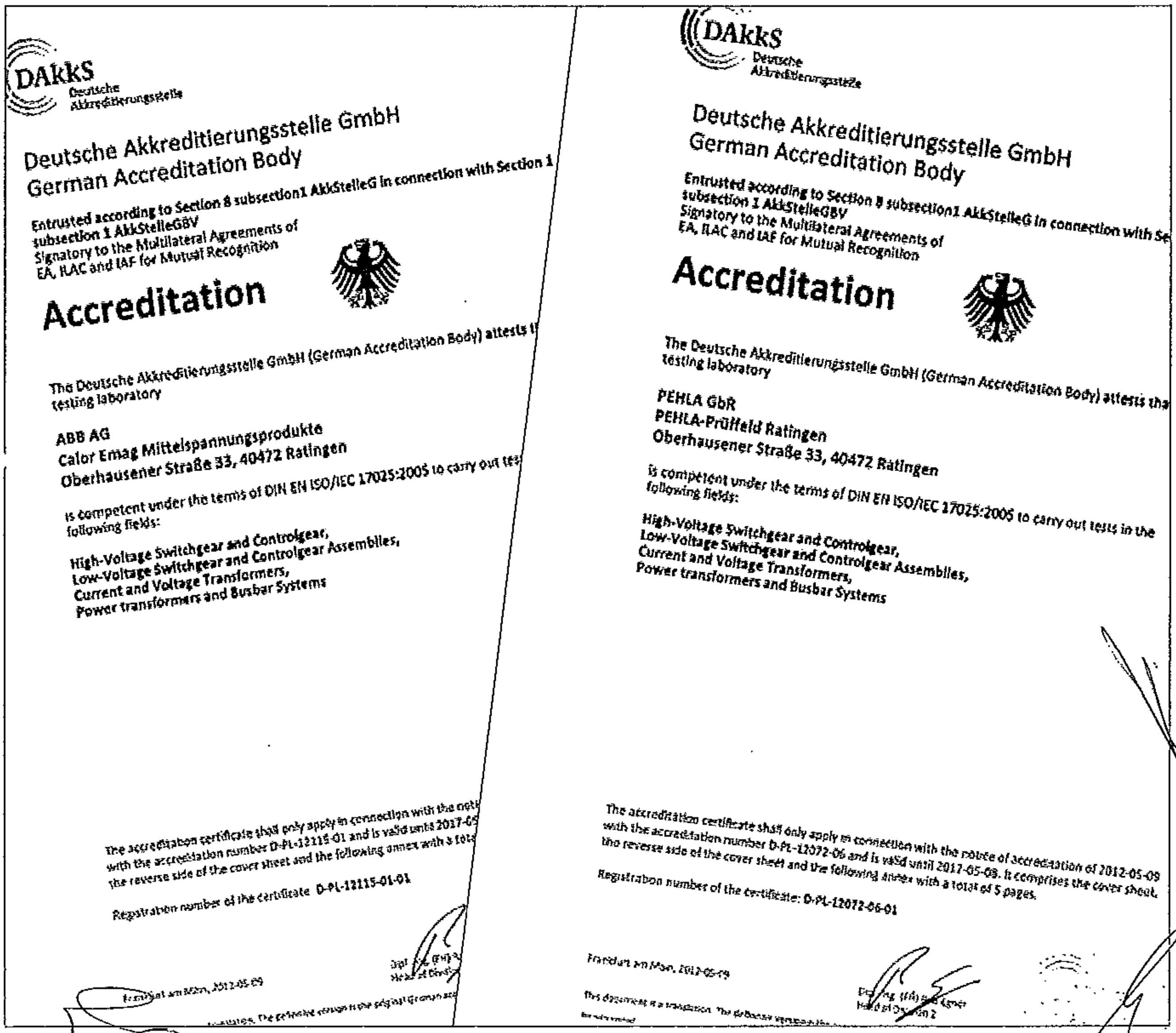


ABB Laboratories, Ratingen, Germany
PEHLA Testing Laboratories, Ratingen, Germany

Power and productivity
for a better world™ ABB

Introducing Laboratories Ratingen

Since 1954, the laboratories of ABB AG – Calor Emag Medium Voltage Products have performed tests on medium voltage equipment. Our laboratories, which are located in Ratingen, Germany, contain all the facilities necessary for tests in the medium voltage range.
The ABB Laboratories Ratingen and PEHLA Testing Laboratories Ratingen are accredited by the German Accreditation Authority (DAkkS). As a shareholder of PEHLA GbR we are also a member laboratory of the Short-circuit Testing Liaison. We provide our customers with high performance and independent testing carried out in accordance with customer requirements or national and international standards.



DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1
subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests t
testing laboratory

ABB AG
Calor Emag Mittelspannungsprodukte
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tes
following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the noti
with the accreditation number D-PL-12115-01 and is valid until 2017-05
the reverse side of the cover sheet and the following annex with a tota

Registration number of the certificate D-PL-12115-01-01

Frankfurt am Main, 2012-05-09

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Se
subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests tha
testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the
following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09
with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet,
the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: D-PL-12072-06-01

Frankfurt am Main, 2012-05-09

Head of Division 2

This document is a translation.

ВЯРНО С ОРИГИНАЛА

Why testing at Laboratories Ratingen?

With 60 years of experience we know how to perform tests professionally. Starting with the planning and preparation phase we cooperate closely with our customers in order to ensure an optimal testing. Our organization provides flexible planning which ensures short-term reservation.
When testing at the Laboratories Ratingen our customers may choose to either prepare the test objects on their own or make use of our assembly and installation service. By request an on-site testing can be performed in the customer's facilities. All test results will be evaluated by our team of highly qualified and experienced experts in close cooperation with the customers. Our laboratories are equipped with a SF_6 module to handle and recycle the gas for environmental safety. The accreditation as ABB Laboratories Ratingen and as PEHLA Testing Laboratories Ratingen ensures that all tests are fully independent.

Services we provide:
- On-site testing and diagnostics with mobile test equipment
- Independent witnessing of tests
- Inspections, examinations and diagnostics
- Manufacturing of prototypes and individual parts
- Assembly of prototypes and test objects
- Assembly and installation work
- Calibration of electrical and mechanical measuring equipment

Our documentation to the customers

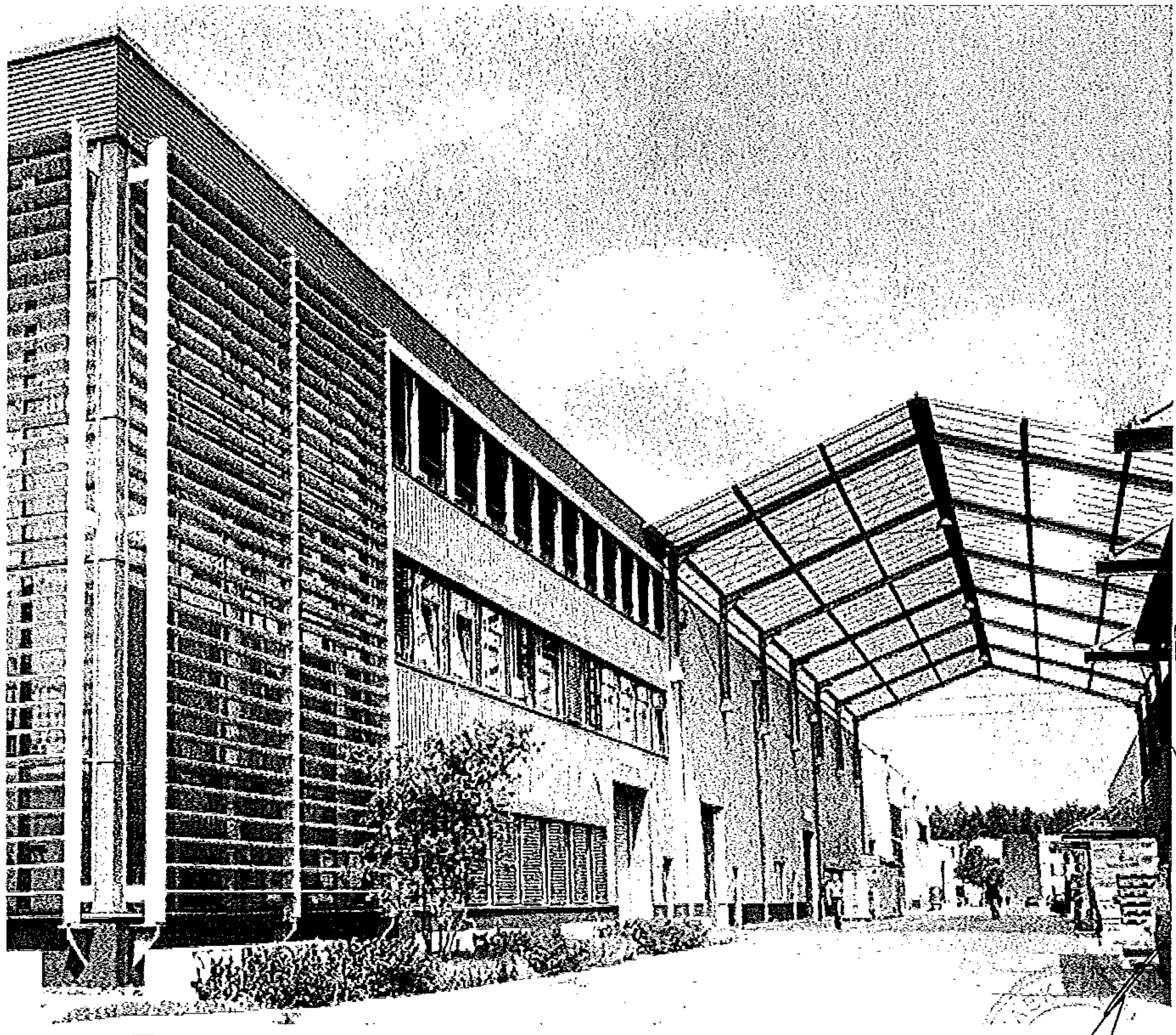
When testing at Laboratories Ratingen different types of documentation can be issued.

Type test certificate
A type test certificate is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

Test document
A test document is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

Test report
A test report is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

Test confirmation
A test confirmation is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.



ВЯРНО С ОРИГИНАЛА

Development tests, type tests or acceptance tests

Laboratories Ratingen are able to offer any kind of test your company needs.

The laboratories are fully equipped to perform complete type tests on medium voltage equipment with state-of-the-art technology. All tests can be carried out as ABB tests or as PEHLA tests.

Tests we provide
- Type tests
- Development tests
- Acceptance tests (also in other test laboratories)
- Certification tests

Our test portfolio:

Tests \ Products	MV circuit-breaker	Metal enclosed switchgear	Power transformer	Disconnector & earthing switch	Switch fuse unit	Earthig facility	Bushing	Instrument transformer	Fuse	Cable accessoriy	Auxiliary circuit	Substation
Making and Breaking test	●	●		●	●				●		●	●
STC test	●	●	●	●		●	●	●		●	●	●
Internal arc test		●										●
Capacitive switching test	●			●								
Temperature rise test	●	●		●	●	●	●	●	●	●	●	●
Climatic test	●	●	●	●	●	●	●	●	●	●	●	
Dielectric test	●	●		●	●	●	●	●	●	●	●	●
IP/IK-coding test	●	●										●
Partial discharge test	●	●		●	●	●	●	●		●		●
Mechanical operation test	●	●		●	●						●	
Mechanical endurance test	●			●	●						●	
High and low temperature test	●	●		●			●		●		●	
Tightness test	●	●		●			●					
Pressure test	●	●		●								

● Tests at Ratingen possible

☐ Tests not applicable to this product

ВЯРНО С ОРИГИНАЛА

Overview of standards

High-voltage switchgear and controlgear	IEC 62271-1	IEC 62271-100	IEC 62271-102
	IEC 62271-103	IEC 62271-104	IEC 62271-105
	IEC 62271-106	IEC 62271-110	IEC 62271-111
	IEC 62271-200	IEC 62271-201	IEC 62271-202
	IEC 62271-203	IEC 62271-304	IEC 60529
High-voltage test techniques	IEC 60060-1	IEC 60060-2	IEC 60270
Power transformers	IEC 60076-5	IEC 60076-11	
High-voltage fuses	IEC 60282-1	IEC 60282-2	
Bushings	IEC 60137		
Insulators	IEC 60660		
Instrument transformers	IEC 61869-1	IEC 61869-2	IEC 61869-3
Live working	IEC 60832-1	IEC 60832-2	IEC 61230
Low-voltage switchgear and controlgear	IEC 60947-1	IEC 60947-2	IEC 60947-3
ANSI / IEEE	IEEE C37.04 ANSI C37.54	ANSI C37.06 IEEE C37.60	IEEE C37.09

Other standards on request.

ВЯРНО С ОРИГИНАЛА

Testing facilities

The Laboratories Ratingen are coordinating tests very well even if different kind of tests in more than one laboratory are required. Customers, who need various tests, can therefore rely on well-organized test procedures – quickly and at fair conditions.

High-power testing laboratory

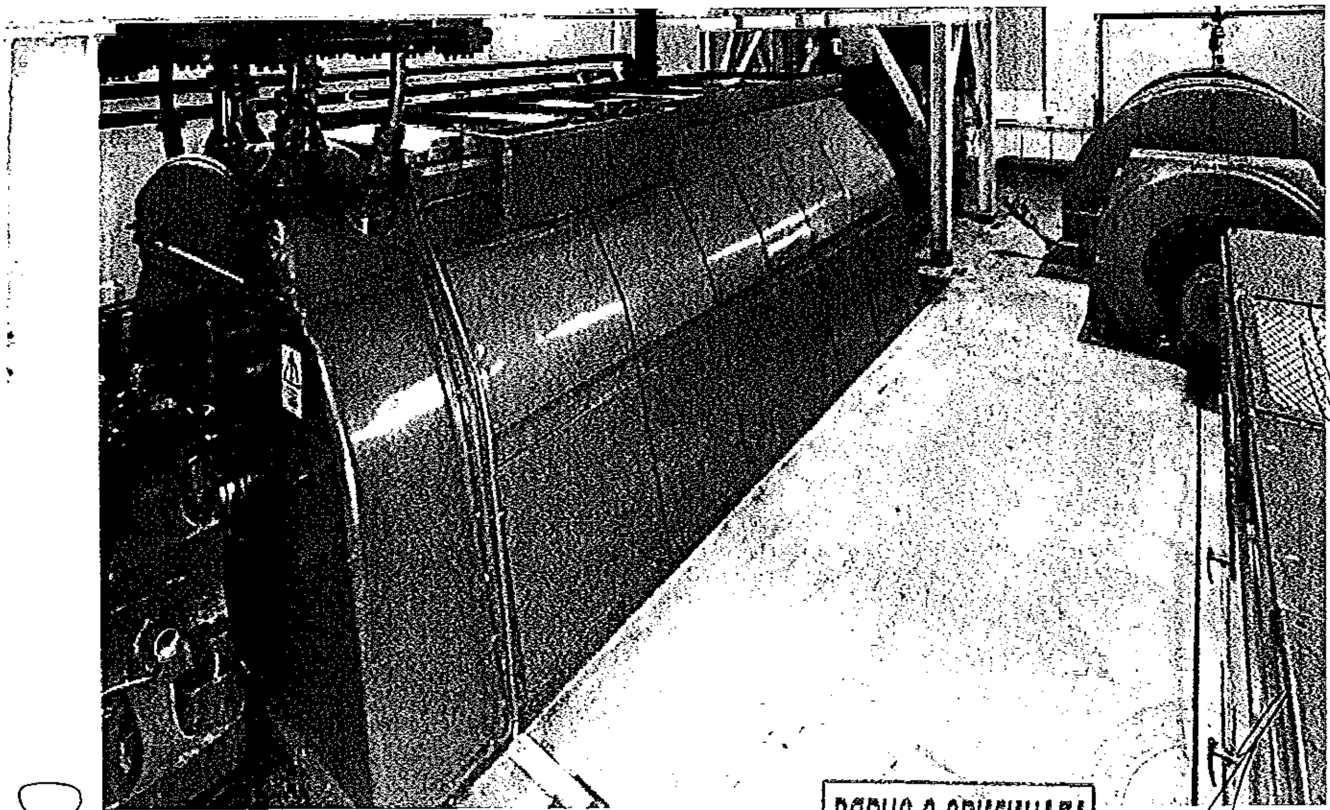
The high power testing laboratory is equipped with a 2800 MVA short-circuit test generator and oil-insulated power transformers and is therefore able to perform making and breaking tests at several voltage- and short-circuit current levels.

A special dry-type power transformer is available to perform peak-withstand current- and short-time withstand current test up to 250 kA and 100 kA r.m.s for three seconds.

Inside the room simulation of the arcing test bay, internal arcing tests can be performed for switchgear, containers or even substations.

A capacitor bank allows to perform different capacitive tests (e.g. line- or cable-charging current switching tests, back-to-back- and single-capacitor-bank current switching tests).

With the miscellaneous equipment like different reactors and resistors, measurement equipment etc., it is possible to perform a wide range of load current switching tests as well.

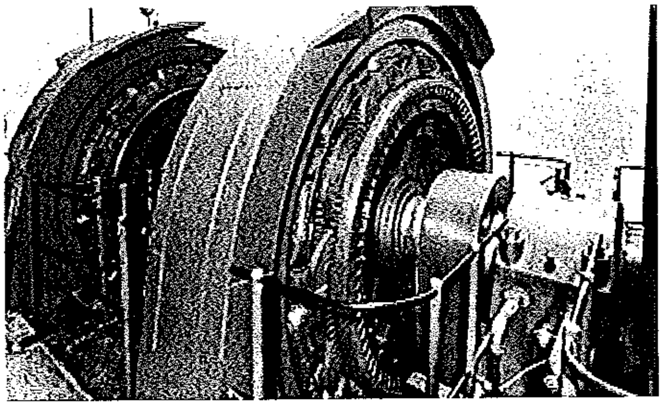


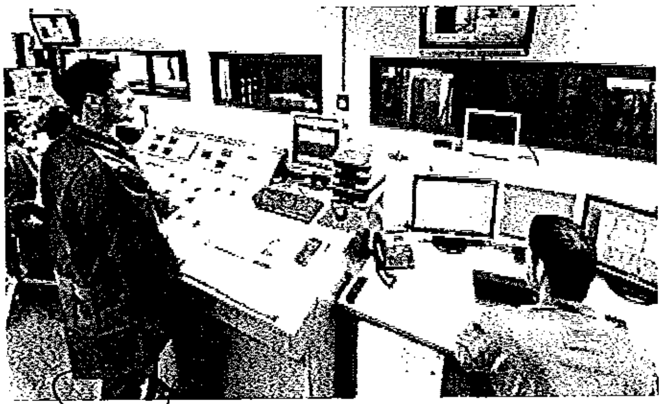
ВЯРНО С ОРИГИНАЛА

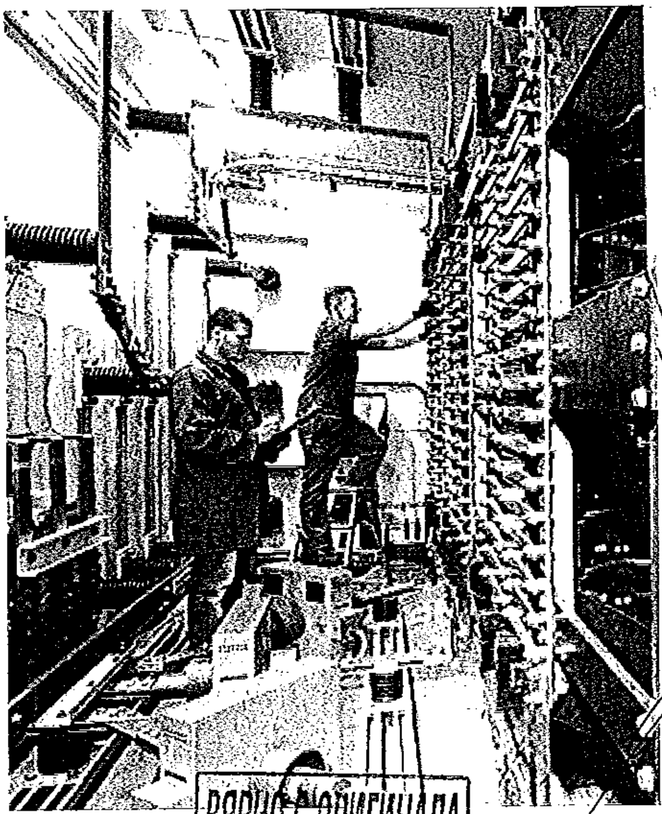
Testing facilities

The tests, which can be performed at our high power testing laboratory, are:

- Short-circuit making and breaking capacity test
  up to
  - 50 kA at 12 kV
  - 31.5 kA at 17.5 kV
  - 25 kA at 24 kV
  - 16 kA at 40.5 kV
- Switching capacity test
  Load currents
  - Capacitive
  - Inductive
  - Ohmic
  - Inductive-ohmic
- Peak withstand current test
  - Up to 250 kA
- Short-time withstand current test
  - Up to 100 kA and up to 3s (4s)
- Internal arc fault test
  - Up to 50 kA
- Different tests
  - beyond the standards according to client's instructions







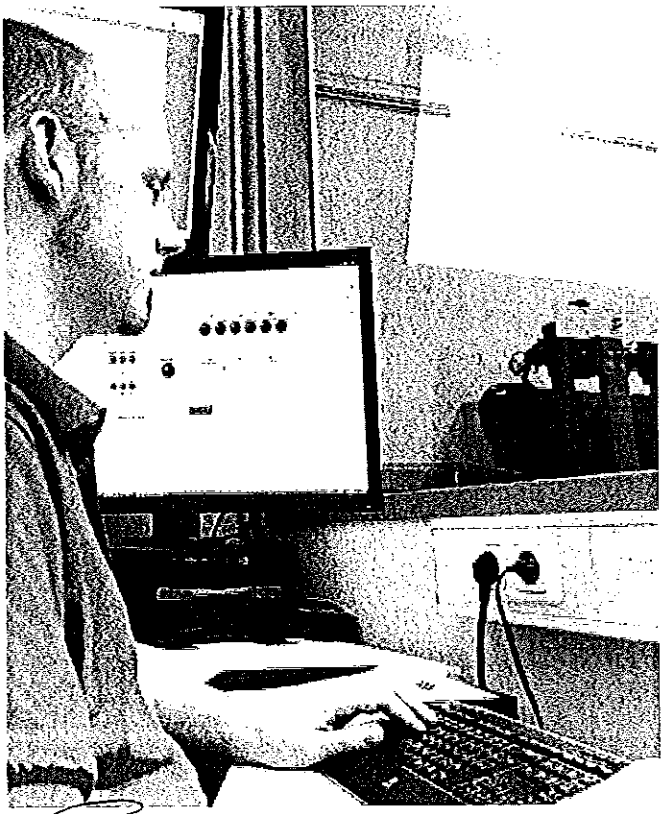
ВЯРНО С ОРИГИНАЛА

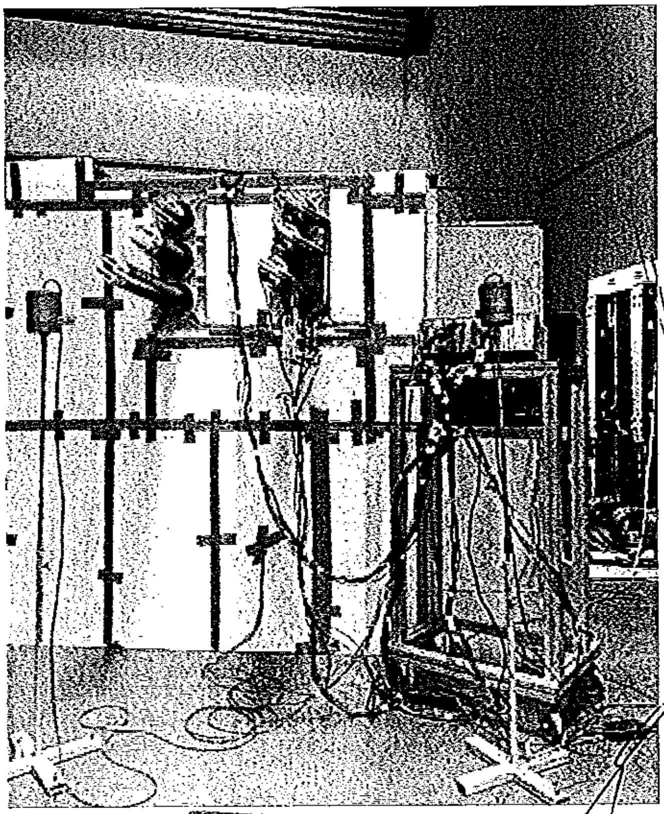
Temperature-rise testing laboratory

The temperature-rise testing laboratory is suited to perform tests with a continuous current up to 5000 A on switchgear and switching devices. Through automated and computer controlled tests we use our recourses in the most efficient and effective way. Therefore we can offer precise, reliable and quick tests during day and night-time to our customers.

During the test, currents and temperatures are checked every 10 minutes. Shorter measurement intervals for currents and temperatures are possible. A control circuit guarantees a constant three-phase current through the entire test. The test is automatically stopped if a temperature limit is exceeded or the test duration is over.

- Temperature-rise tests
  - Up to 180 measuring points can be connected
  - Single-phase and three-phase
    - Up to 5000 A at 50 Hz
    - Up to 4000 A at 60 Hz
- Additionally we can offer
  - Magnetic field measurement
  - Thermal imaging





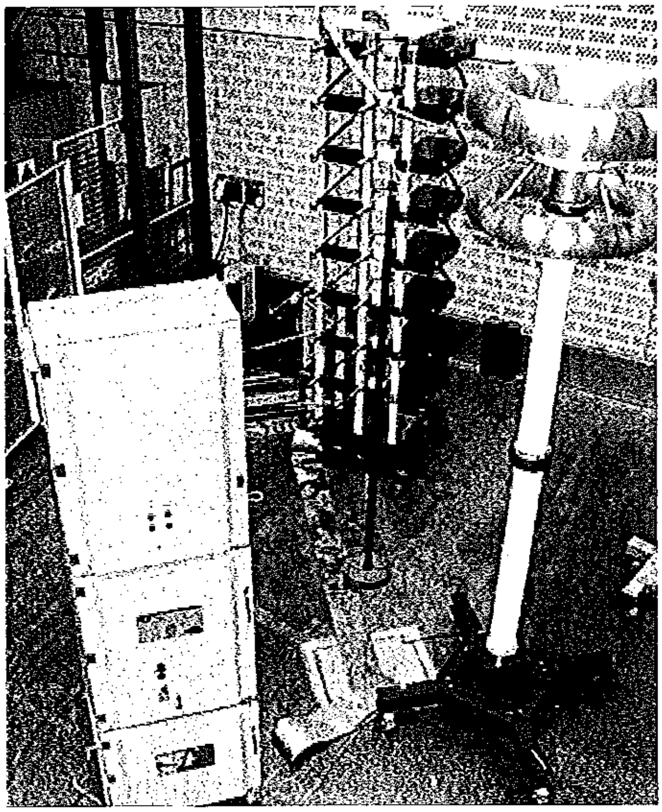
Testing facilities

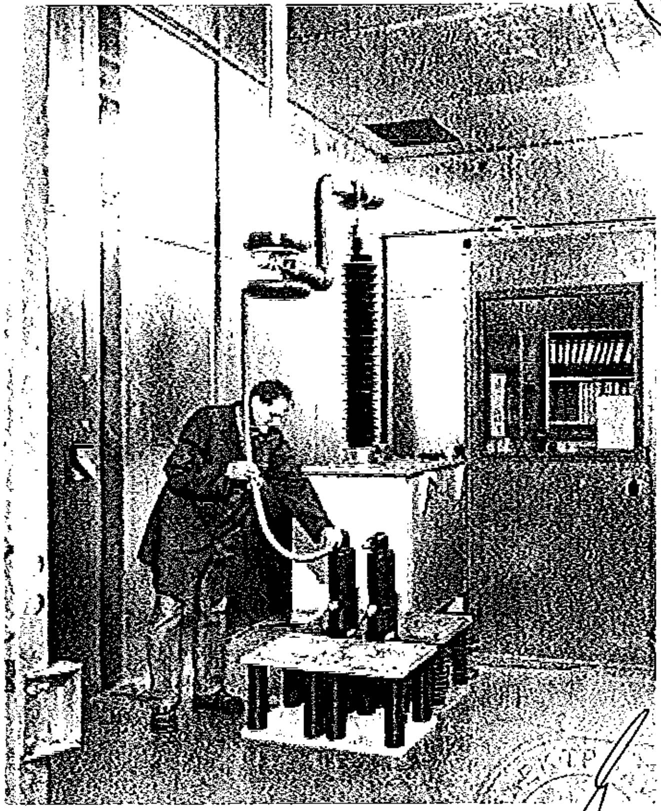
High-voltage testing laboratory
With the test facilities in our high voltage testing laboratory all dielectric and partial discharge tests for medium voltage equipment can be carried out. For sensitive partial discharge tests a special test chamber is available with a background level < 1 pC.

In order to offer on-site testing the high-voltage laboratory has mobile test equipment.

The high-voltage testing laboratory performs the following tests:

- Standard lightning impulse voltage tests
  - Up to 800 kV
- Power-frequency voltage tests
  - Stationary up to 260 kV
  - Mobile up to 230 kV
- Partial discharge tests
  - Stationary up to 150 kV
  - Mobile up to 230 kV
- Degree of protection tests
- Tests on auxiliary and control circuits





Mechanical testing laboratory

The mechanical testing laboratory offers different functional, environmental and material tests especially on medium and low voltage equipment and their components.

The functional tests include endurance tests on switching devices, kinematic chain tests and function tests on any kind of interlocking or control system. For long-duration tests automatic control and monitoring systems are available to supervise various signals for diagnostics.

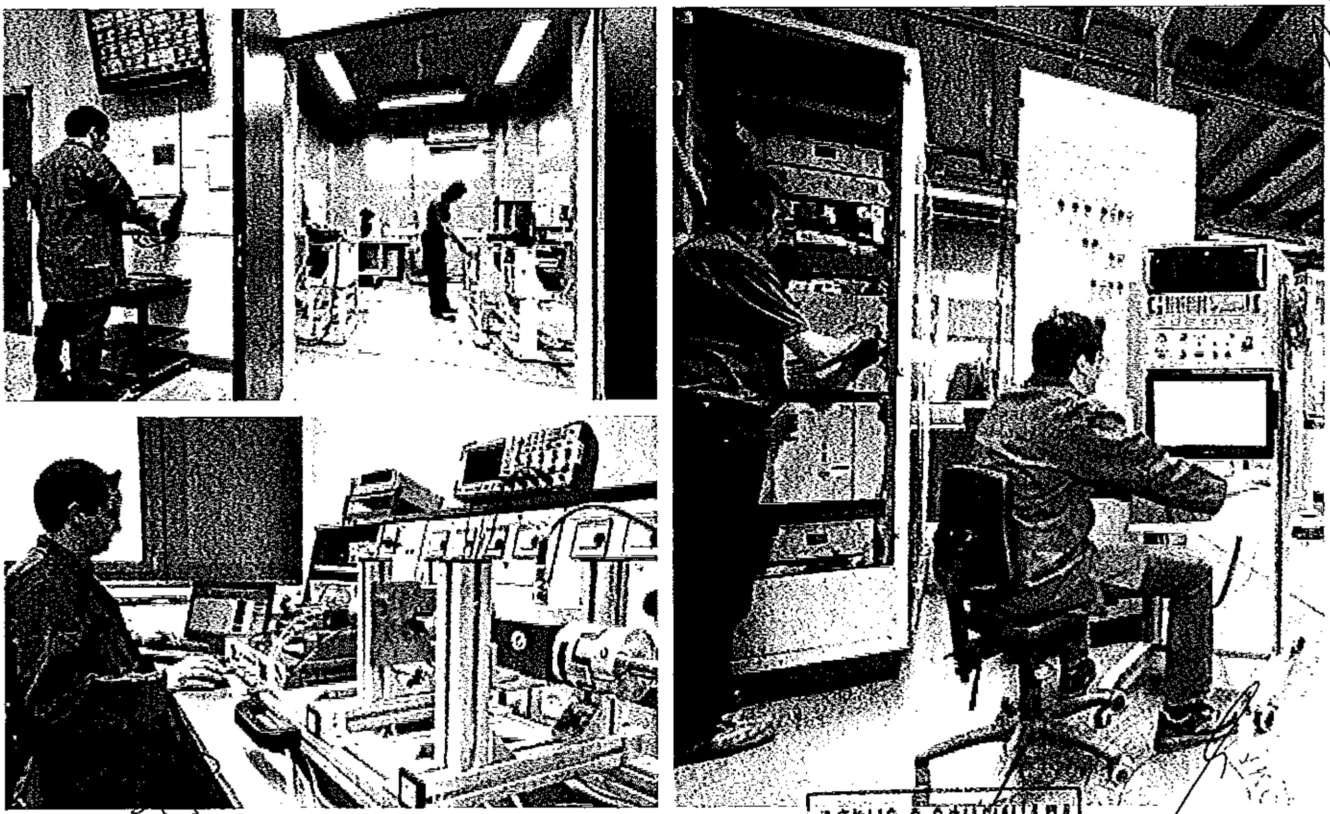
A wide range of measurement equipment is able to record via special sensors many additional data for detailed investigation of the test objects characteristics, like travels, rotation angles, forces, torques, pressures, temperatures, binary signal states and gas densities.

For gas-filled equipment we offer additionally gas-tightness and pressure withstand tests.

The environmental tests combine the above mentioned measurements and functional tests with special conditions during storage and/or operation like extreme temperatures, humidity, vibrations, inclination and other impacts.

Material testing concentrates on load tests like tensile, compression, mechanical impact IK-coding, torsion and bending tests.

High-speed video recording can be used for visual examination of very fast processes (up to 10,000 pic./s).



Testing facilities

Material testing laboratory

In this laboratory various climatic tests on materials, components and complete medium voltage switchgear panels can be carried out.

The testing facilities include two accessible climatic / thermo chambers. The main tests offered by the material testing laboratory are:

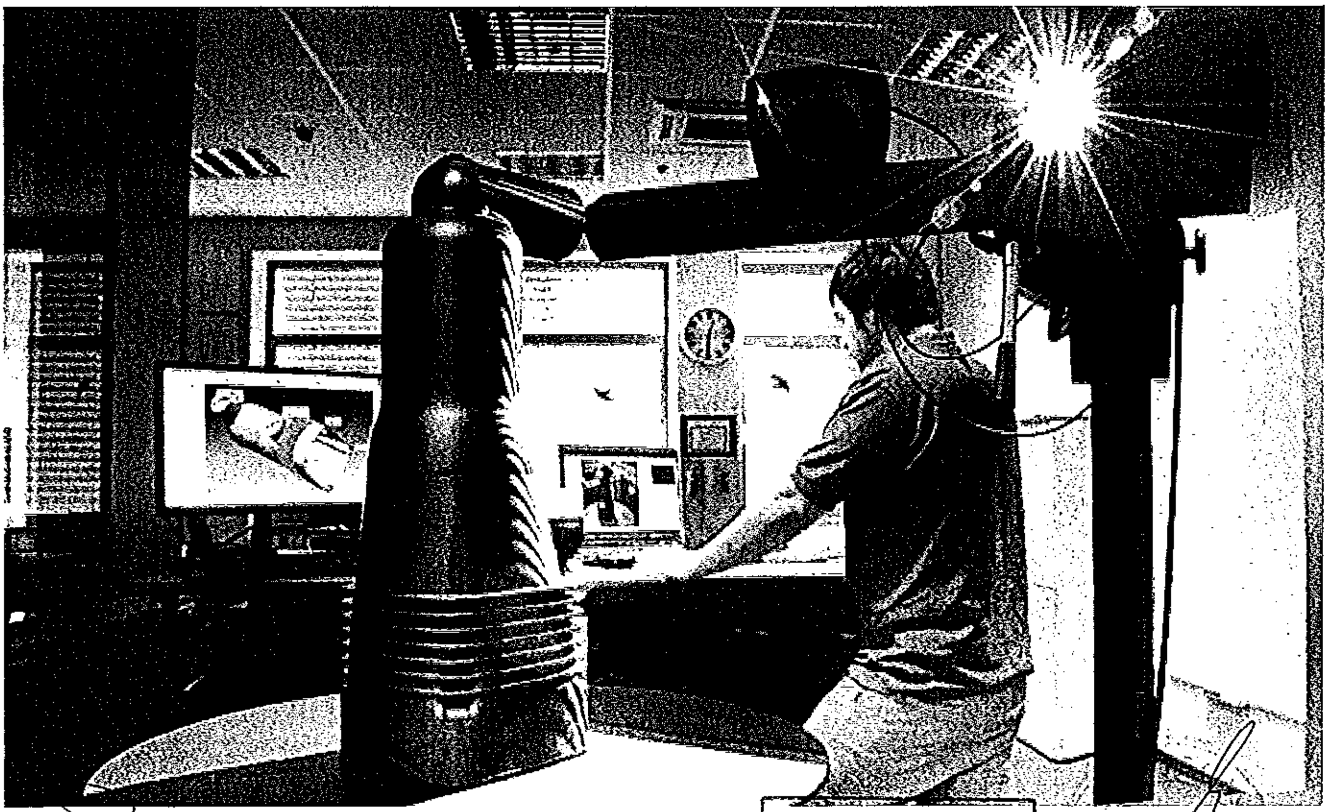
- Temperature tests
  - Range: -70 °C to +150 °C
  - Test voltage: 95 kV (1-phase)
- Climatic tests
  - Temperature range: +20 °C to +90 °C
  - Humidity range: 10 - 98 %
  - Test voltage: 95 kV (1-phase)
- Corrosion tests
  - Salt fog tests
  - Fog tests with sulfur dioxide
  - Tests with condensed water containing climate

Calibration service

At the calibration laboratory we are able to calibrate electrical measurement instruments, force measurement instruments, length measurement equipment, torque wrenches and pressure gas equipment.

Initial sampling inspection
Objects with different size can be digitized with top-quality by 3D-scanning.

The 3D scanner will also be used for
- Quality checks
  - Comparison of nominal/actual measurement data according to CAD data set
  - Measurement of form and position tolerances without complex construction
  - Measurement of free formed surfaces
  - Serial measurement for quality checks, process safety
- Toolroom
  - Generation of drawings for CAD system derives from scan process
  - Check of initial batches

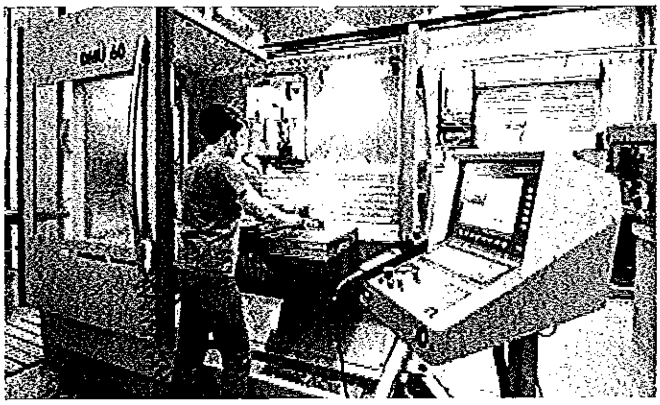


Workshop of the Laboratories

The workshop manufactures prototypes and test arrangements as well as provides complete assembly and installation service in connection with tests.

If defects occur during tests our workshop offers immediate repair service and manufacturing of spare parts.

In order to offer optimal service the workshop is fully equipped for all kind of metal processing.



ВЯРНО С ОРИГИНАЛА

Contacts at the Laboratories Ratingen

If you need more information on Laboratories Ratingen or if you would like to make reservations for a test please contact:

General manager
Dr. Stefan Göttlich
Phone: +49 2102 12-1736
Fax: +49 2102 12-1713
E-Mail: stefan.goettlich@de.abb.com

Manager of high-power testing laboratory
Dr. Martin Wember
Phone: +49 2102 12-1353
Fax: +49 2102 12-1713
E-Mail: martin.wember@de.abb.com

Manager of temperature-rise, material testing and calibration laboratory
Claus Loquingen
Phone: +49 2102 12-1372
Fax: +49 2102 12-1713
E-Mail: claus.loquingen@de.abb.com

Manager of high-voltage testing laboratory
Ralf Hutmacher
Phone: +49 2102 12-1968
Fax: +49 2102 12-1713
E-Mail: ralf.hutmacher@de.abb.com

Manager of mechanical testing and electronic laboratory
Michael Schöttler
Phone: +49 2102 12-1703
Fax: +49 2102 12-1713
E-Mail: michael.schoettler@de.abb.com

Manager of workshop
Reiner Huhle
Phone: +49 2102 12-1277
Fax: +49 2102 12-1713
E-Mail: reiner.huhle@de.abb.com

Contact

ABB AG
Calor Emag Medium Voltage Products
Oberhausener Strasse 33
40472 Ratingen, Germany
Phone: +49 2102 12-0
Fax: +49 2102 12-17 77
E-Mail: powertech@de.abb.com

www.abb.com/laboratories-ratingen

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Power and productivity
for a better world™

ВЯРНО С ОРИГИНАЛА

Deutsche Akkreditierungsstelle GmbH

Anlage zur Akkreditierungsurkunde D-PL-12115-01-00 nach DIN EN ISO/IEC 17025:2005

Gültigkeitsdauer: 20.04.2017 bis 19.04.2022 Ausstellungsdatum: 20.04.2017

Urkundeninhaber:

ABB AG
Kallstater Str. 1, 68309 Mannheim

Standort:
ABB AG
Calor Emag Mittelspannungsprodukte
Oberhausener Straße 33, 40472 Ratingen

Prüfungen in den Bereichen:

Geräte und Anlagen der Nieder-, Mittel- und Hochspannung

Dem Prüflaboratorium ist, ohne dass es einer vorherigen Information und Zustimmung der DAkkS bedarf, die Anwendung der hier aufgeführten genormten oder ihnen gleichzusetzenden Prüfverfahren mit unterschiedlichen Ausgabeständen gestattet.

Das Prüflaboratorium verfügt über eine aktuelle Liste aller Prüfverfahren im flexiblen Akkreditierungsbereich.

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-1 VDE 0414-9-1: April 2010 IEC 61869-1 Edition 1.0, 2007-10	Messwandler – Teil 1: Allgemeine Anforderungen (IEC 61869-1:2007, modifiziert); Deutsche Fassung EN 61869-1:2009 Instrument transformers – Part 1: General requirements (IEC 61869-1:2007, modified); German version EN 61869-1:2009	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-2 VDE 0414-9-2: 2013-07 + DIN EN 61869-2 Berichtigung 1: 2014-06; VDE 0414-9-2 Berichigung 1: 2014-06 IEC 61869-2 Edition 1.0, 2012-09	Messwandler – Teil 2: Zusätzliche Anforderungen für Stromwandler (IEC 61869-2:2012); Deutsche Fassung EN 61869-2:2012 Instrument transformers – Part 2: Additional requirements for current transformers (IEC 61869-2:2012); German version EN 61869-2:2012	
Elektrotechnik	DIN EN 61869-3 (VDE 0414-9-3): Mai 2012 IEC 61869-3 Edition 1.0, 2011-07	Messwandler – Teil 3: Zusätzliche Anforderungen für induktive Spannungswandler (IEC 61869-3:2011); Deutsche Fassung EN 61869-3:2011 Instrument transformers – Part 3: Additional requirements for inductive voltage transformers (IEC 61869-3:2011); German version EN 61869-3:2011	
Elektrotechnik	DIN EN 61869-4 VDE 0414-9-4: April 2015 IEC 61869-4 Edition 1.0, 2013-11	Messwandler - Teil 4: Zusätzliche Anforderungen für kombinierte Wandler (IEC 61869-4:2013) Deutsche Fassung EN 61869-4:2014 Instrument transformers - Part 4: Additional requirements for combined transformers German version EN 61869-4:2014	
Elektrotechnik	DIN EN 61869-5 (VDE 0414-9-5) Mai 2012 IEC 61869-5 Edition 1.0, 2011-07	Messwandler - Teil 5: Zusätzliche Anforderungen für kapazitive Spannungswandler (IEC 61869-5:2011); Deutsche Fassung EN 61869-5:2011 Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers (IEC 61869-5:2011); German version EN 61869-5:2011	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60060-1 (VDE 0432-1) Oktober 2011 IEC 60060-1 Edition 3.0, 2010-09	Hochspannungs-Prüftechnik – Teil 1: Allgemeine Begriffe und Prüfbedingungen (IEC 60060-1:2010); Deutsche Fassung EN 60060-1:2010 High-voltage test techniques – Part 1: General definitions and test requirements (IEC 60060-1:2010); German version EN 60060-1:2010	
Elektrotechnik	DIN EN 60060-2 (VDE 0432-2) Oktober 2011 IEC 60060-2 Edition 3.0, 2010-11	Hochspannungs-Prüftechnik – Teil 2: Messsysteme (IEC 60060-2:2010); Deutsche Fassung EN 60060-2:2011 High-voltage test techniques – Part 2: Measuring systems (IEC 60060-2:2010); German version EN 60060-2:2011	(without annex A) (ohne Anhang A)
Elektrotechnik	DIN EN 60076-5 (VDE 0532-76-5) Januar 2007 IEC 60076-5 Third Edition, 2006-02	Leistungstransformatoren – Teil 5: Kurzschlussfestigkeit (IEC 60076-5:2006); Deutsche Fassung EN 60076-5:2006 Power transformers – Part 5: Ability to withstand short-circuit (IEC 60076-5:2006); German version EN 60076-5:2006	
Elektrotechnik	DIN EN 60076-11 (VDE 0532-76-11) April 2005 IEC 60076-11 First Edition, 2004-05	Leistungstransformatoren – Teil 11: Trockentransformatoren (IEC 60076-11:2004); Deutsche Fassung EN 60076-11:2004 Power transformers – Part 11: Dry-type transformers (IEC 60076-11:2004); German version EN 60076-11:2004	
Elektrotechnik	DIN EN 60137 (VDE 0674-5) Juli 2009 IEC 60137	Isolierte Durchführungen für Wechselspannungen über 1 000 V (IEC 60137:2008); Deutsche Fassung EN 60137:2008 Insulated bushings for alternating voltages above	

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	Edition 6.0, 2008-07	1000 V (IEC 60137:2008); German version EN 60137:2008	
Elektrotechnik	DIN EN 62271-103 (VDE 0671-103) April 2012 IEC 62271-103 Edition 1.0, 2011-06	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 103: Lastschalter für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-103:2011); Deutsche Fassung EN 62271-103:2011 High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV (IEC 62271-103:2011); German version EN 62271-103:2011	
Elektrotechnik	DIN EN 62271-104 (VDE 0671-104) November 2015 IEC 62271-104 Edition 2.0, 2015-02	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 104: Wechselstrom-Lastschalter für Bemessungsspannungen über 52 kV (IEC 62271-104:2015); Deutsche Fassung EN 62271-104:2015 High-voltage switchgear and controlgear – Part 104: Alternating current switches for rated voltages higher than 52 kV (IEC 62271-104:2015); German version EN 62271-104:2015	

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Elektrotechnik	DIN EN 60270 (VDE 0434) August 2001 + DIN EN 60270 Berichtigung 1: November 2002; VDE 0414-9-2 Berichigung 1: November 2002	Hochspannungs-Prüftechnik Teilentladungsmessungen (IEC 60270:2000) Deutsche Fassung EN 60270:2001	
	IEC 60270 Third edition, 2000-12 + Amendement 1 Third edition, 2015-11	High-voltage test techniques – Partial discharge measurement (IEC 60270:2000); German version EN 60270:2001	
Elektrotechnik	DIN EN 60282-1 (VDE 0670-4) August 2010	Hochspannungssicherungen Teil 1: Strombegrenzende Sicherungen (IEC 60282-1:2009) Deutsche Fassung EN 60282-1:2009	
	IEC 60282-1 Edition 7.1, 2014-07	High-voltage fuses – Part 1: Current-limiting fuses (IEC 60282-1:2009); German version EN 60282-1:2009	
Elektrotechnik	IEC 60282-2 Edition 3.0, 2008-04	High-voltage fuses – Part 2: Expulsion fuses	
Elektrotechnik	DIN EN 62271-106 (VDE 0671-106) Juni 2011	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 106: Wechselstrom-Schütze, Kombinationsstarter und Motorstarter mit Schützen (IEC 62271-106:2011); Deutsche Fassung EN 62271-106:2011	
	IEC 62271-106 Edition 1.0, 2011-08	High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters (IEC 62271-106:2011); German version EN 62271-106:2011	

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Elektrotechnik	DIN EN 60529 (VDE 0470-1) September 2014	Schutzarten durch Gehäuse (IP-Code) (IEC 60529:1989 + A1:1999 + A2:2013) Deutsche Fassung EN 60529:1991 + A1: 2000 + A2:2013	
	IEC 60529 Edition 2.2, 2013-08	Degree of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999 + A2:2013) German version EN 60529:1991 + A1: 2000 + A2:2013	
Elektrotechnik	DIN EN 60660 (VDE 0441-3) Dezember 2000	Isolatoren Prüfungen an Innenraum-Stützern aus organischem Werkstoff für Netze mit Nennspannungen über 1 kV bis kleiner 300 kV (IEC 60660:1999) Deutsche Fassung EN 60660:1999	
	IEC 60660 Edition 2.0, 1999-10	Insulators – Tests on indoor post insulators of organic material for systems with nominal voltages greater than 1 kV up to but not including 300 kV (IEC 60660:1999); German version EN 60660:1999	
Elektrotechnik	DIN EN 60832-1 (VDE 0682-211) Dezember 2010	Arbeiten unter Spannung – Isolierende Stangen und auswechselbare Arbeitsköpfe – Teil 1: Isolierende Stangen (IEC 60832-1:2010) Deutsche Fassung EN 60832-1:2010 + Cor.:2010	
	IEC 60832-1 Edition 1.0, 2010-02	Live working - Insulating sticks and attachable devices - Part 1: Insulating sticks (IEC 60832-1:2010) German version EN 60832-1:2010 + Cor.:2010	
Elektrotechnik	DIN EN 60832-2 (VDE 0682-212) Dezember 2010	Arbeiten unter Spannung – Isolierende Stangen und auswechselbare Arbeitsköpfe Teil 2: Auswechselbare Arbeitsköpfe (IEC 60832-2:2010); Deutsche Fassung EN 60832-2:2010 + Cor.:2010	
	IEC 60832-2 Edition 1.0, 2010-02	Live working - Insulating sticks and attachable devices - Part 2: Attachables devices (IEC 60832-2:2010); German version EN 60832-2:2010 + Cor.:2010	

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Elektrotechnik	DIN EN 60947-1: (VDE 0660-100) Oktober 2011	Niederspannungsschaltgeräte – Teil 1: Allgemeine Festlegungen (IEC 60947-1:2007 + A1:2010); Deutsche Fassung EN 60947-1:2007 + A1:2011	
	DIN EN 60947-1/A2 (VDE 0660-100/A2) Mai 2014	Niederspannungsschaltgeräte – Teil 1: Allgemeine Festlegungen (IEC 17B/1806/CDV:2013); Deutsche Fassung EN 60947-1:2007/FprA2:2013	
	IEC 60947-1 Edition 5.2 2014-09 + Amendement 1 + 2	Low-voltage switchgear and controlgear - Part 1: General rules (IEC 60947-1:2007 + A1:2010); German version EN 60947-1:2007 + A1:2011	
Elektrotechnik	DIN EN 60947-2: VDE 0660-101 Januar 2014	Niederspannungsschaltgeräte – Teil 2: Leistungsschalter (IEC 60947-2:2006 + A1:2009 + A2:2013); Deutsche Fassung EN 60947-2:2006 + A1:2009 + A2:2013	
	DIN EN 60947-2 (VDE 0660-101) März 2015	Niederspannungsschaltgeräte – Teil 2: Leistungsschalter (IEC 121A/26/CDV:2014); Deutsche Fassung FprEN 60947-2:2014	
	IEC 60947-2 Edition 5.0 2016-06	Low-voltage switchgear and controlgear – Part 2: Circuit-breakers (IEC 60947-2: 2016); German version EN 60947-2:2006 + A1:2009 + A2:2013	

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Elektrotechnik	DIN EN 60947-3: VDE 0660-10 Dezember 2012	Niederspannungsschaltgeräte - Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 60947-3:2008 + A1:2012); Deutsche Fassung EN 60947-3:2009 + A1:2012	
	DIN EN 60947-3 Berichtigung 1 (VDE 0660-107 Berichtigung 1) März 2015	Niederspannungsschaltgeräte – Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 60947-3:2008 + A1:2012); Deutsche Fassung EN 60947-3:2009 + A1:2012, Berichtigung zu DIN EN 60947-3 (VDE 0660-107):2012-12; (IEC-Cor.:2013 zu IEC 60947-3:2008/A1:2012)	
	DIN EN 60947-3/A2:2015-03; VDE 0660-107/A2:2015-03	Niederspannungsschaltgeräte – Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 121A/7/CDV:2014); Deutsche Fassung EN 60947-3:2009/FprA2:2014	
	IEC 60947-3 Edition 3.1 2012-04 + Amendement 1	Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units (IEC 60947-3:2008 + A1:2012); German version EN 60947-3:2009 + A1:2012	
Elektrotechnik	DIN EN 61230, (VDE 0683-100) Juli 2009	Ortsveränderliche Geräte zum Erden oder Erden und Kurzschließen (IEC 61230:2008); Deutsche Fassung EN 61230:2008	
	IEC 61230 Edition 2.0, 2008-07	Live working - Portable equipment for earthing or earthing and short-circuiting (IEC 61230:2008); German version EN 61230:2008	

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Elektrotechnik	DIN EN 61869-1 VDE 0414-9-1 April 2010 IEC 61869-1 Edition 1.0, 2007-10	Messwandler Teil 1: Allgemeine Anforderungen (IEC 61869-1:2007, modifiziert); Deutsche Fassung EN 61869-1:2009 Instrument transformers - Part 1: General requirements (IEC 61869-1:2007, modified); German version EN 61869-1:2009	
Elektrotechnik	DIN EN 62271-1 VDE 0671-1 August 2009 + DIN EN 62271-1/A1 VDE 0671-1/A1 April 2012 IEC 62271 Edition 1.1, 2011-08	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 1: Gemeinsame Bestimmungen (IEC 62271-1:2007); Deutsche Fassung EN 62271-1:2008 Hochspannungs-Schaltgeräte und –Schaltanlagen Teil 1: Gemeinsame Bestimmungen (IEC 62271-1:2007/A1:2011); Deutsche Fassung EN 62271-1:2008/A1:2011 High-voltage switchgear and controlgear - Part 1: Common specifications (IEC 62271-1:2007); German version EN 62271-1:2008	
Elektrotechnik	DIN EN 62271-100 VDE 0671-100 August 2013 IEC 62271-100 Edition 2.1, 2012-09	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 100: Wechselstrom-Leistungsschalter (IEC 62271-100:2008 + A1:2012); Deutsche Fassung EN 62271-100:2009 + A1:2012 High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers (IEC 62271-100:2008 + A1:2012); German version EN 62271-100:2009 + A1:2012	

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Elektrotechnik	DIN EN 62271-102 VDE 0671-102 August 2013 +	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter (IEC 62271-102:2001 + Corrigenda 2002 & 2003 + A1:2011); Deutsche Fassung EN 62271-102:2002 + Cor.:2008 + A1:2011	
	DIN EN 62271-102/A2 VDE 0671-102/A2 Dezember 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter (IEC 62271-102:2001/A2:2013); Deutsche Fassung EN 62271-102:2002/A2:2013	
	IEC 62271-102 Edition 1.2, 2013-02	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches (IEC 62271-102:2001 + Corrigenda 2002 & 2003 + A1:2011 + A2:2013); German version EN 62271-102:2002 + Cor.:2008 + A1:2011 + A2:2013	
Elektrotechnik	DIN EN 62271-105 VDE 0671-105 August 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 105: Wechselstrom-Lastschalter-Sicherungs-Kombinationen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-105:2012); Deutsche Fassung EN 62271-105:2012	
	IEC 62271-105 Edition 2.0, 2012-09	High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV (IEC 62271-105:2012); German version EN 62271-105:2012	
Elektrotechnik	DIN EN 62271-110 VDE 0671-110 August 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 110: Schalten induktiver Lasten (IEC 62271-110:2012 + corrigendum Oct. 2012); Deutsche Fassung EN 62271-110:2012	
	IEC 62271-110 Edition 3.0, 2012-09	High-voltage switchgear and controlgear – Part 110: Inductive load switching (IEC 62271-110:2012 + corrigendum Oct. 2012); German version EN 62271-110:2012	

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Elektrotechnik	E DIN EN 62271-111 VDE 0671-111 September 2014	Hochspannungs-Schaltgeräte -und Schaltanlagen Teil 111: Automatische Wiedereinschalter und Fehlerunterbrecher für Wechselspannungssysteme bis 38 kV (IEC 17A/1060/CD:2014)	
	IEC 62271-111: 2012(E) IEEE Std C37.60-2012(E) Edition 2.0 2012-09	High-voltage switchgear and controlgear – Part 111: Automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV	
Elektrotechnik	DIN EN 62271-200 VDE 0671-200 August 2012 + Berichtigung 1	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 200: Metallgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-200:2011); Deutsche Fassung EN 62271-200:2012 + Berichtigung 1:2016-01	
	IEC 62271-200 Edition 2.0, 2011-10 + Corrigendum 1	High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (IEC 62271-200:2011 + Corrigenda 2015); German version EN 62271-200:2012 + Berichtigung 1:2016-01	
Elektrotechnik	DIN EN 62271-201 VDE 0671-201 Juli 2007	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 201: Isolierstoffgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-201:2006); Deutsche Fassung EN 62271-201:2006	
	IEC 62271-201 Edition 2.0, 2014-03	High-voltage switchgear and controlgear - Part 201: AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (IEC 62271-201:2014);	

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Elektrotechnik	DIN EN 62271-202 VDE 0671-202 August 2007	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 202: Fabrikfertige Stationen für Hochspannung/Niederspannung (IEC 62271-202:2006); Deutsche Fassung EN 62271-202:2007	
	IEC 62271-202 Edition 2.0, 2014-03	High-voltage switchgear and controlgear – Part 202: High-voltage/ low-voltage prefabricated substation (IEC 62271-202:2014);	
Elektrotechnik	DIN EN 62271-203 VDE 0671-203 November 2012	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 203: Gasisolierte metallgekapselte Schaltanlagen für Bemessungsspannungen über 52 kV (IEC 62271-203:2011); Deutsche Fassung EN 62271-203:2012	
	IEC 62271-203 Edition 2.0, 2011-09	High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV (IEC 62271-203:2011); German version EN 62271-203:2012	
Elektrotechnik	E DIN EN 62271-304 VDE 0671-304 April 2007	Zusätzliche Anforderungen an gekapselte Schaltgerätekombinationen und Hochspannungsschaltanlagen von 1 kV bis 52 kV für den Einsatz unter erschwerten klimatischen Bedingungen (IEC 17C/373/CD:2006)	
	IEC/TS 62271-304 Edition 1.0, 2008-05	High-voltage switchgear and controlgear – Part 304: Design classes for indoor enclosed switchgear and controlgear for rated voltages above 1 kV up to and includuing 52 kV to be used in severe climatic conditions (IEC/TS 62271-304:2008)	

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Elektrotechnik	E DIN IEC 62271-37-013 VDE 0671-37-013: 2012-09 IEC/IEEE 62271-37-013 Edition 1.0, 2015-10	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 37-013: Wechselstrom-Generatorschalter (IEC 17A/993/CD:2011) High-voltage switchgear and controlgear – Part 37-013: Alternating-current generator circuit-breakers	
Elektrotechnik	DIN EN 60068-2-1 VDE 0468-2-1 Januar 2008 IEC 60068-2-1 Edition 6.0, 2007-03	Umgebungseinflüsse - Teil 2-1: Prüfverfahren - Prüfung A: Kälte (IEC 60068-2-1:2007); Deutsche Fassung EN 60068-2-1:2007 Environmental testing – Part 2-1: Tests – Test A: Cold (IEC 60068-2-1:2007); German version EN 60068-2-1:2007	
Elektrotechnik	DIN EN 60068-2-2 VDE 0468-2-2 Mai 2008 IEC 60068-2-2 Edition 5.0, 2007-07	Umgebungseinflüsse - Teil 2-2: Prüfverfahren - Prüfung B: Trockene Wärme (IEC 60068-2-2:2007); Deutsche Fassung EN 60068-2-2:2007 Environmental testing – Part 2-2: Tests – Test B: Dry heat (IEC 60068-2-2:2007) German version EN 60068-2-2:2007	
Elektrotechnik	DIN EN 60068-2-30 Juni 2006 IEC 60068-2-30 Edition 3.0, 2005-08	Umgebungseinflüsse - Teil 2-30: Prüfverfahren - Prüfung Db: Feuchte Wärme, zyklisch (12 + 12 Stunden) (IEC 60068-2-30:2005); Deutsche Fassung EN 60068-2-30:2005 Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30:2005) German version EN 60068-2-30:2005	
Elektrotechnik	IEC 62262 Edition 1.0, 2002-02	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) German version SN EN 62262:2002	

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Elektrotechnik	DIN EN 60068-2-75 VDE 0468-2-75 2015-08 IEC 60068-2-75 Edition 2.0, 2014-09	Umgebungseinflüsse - Teil 2-75: Prüfungen - Prüfung Eh: Hammerprüfungen (IEC 60068-2-75:2014); Deutsche Fassung EN 60068-2-75:2014 Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests (IEC 60068-2-75:2014) German version EN 60068-2-75:2014	
Elektrotechnik	IEEE Std C37.04- 1999 June 1999	IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers IEEE Std C37.04-1999 (Revision of IEEE Std C37.04-1979)	
Elektrotechnik	IEEE Std C37.06-2009 November 2009	IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for Voltages Above 1000 V IEEE Std C37.06-2009 (Revision of ANSI C37.06-2000)	
Elektrotechnik	IEEE Std C37.09-1999 (R2007) June 1999	IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis IEEE Std C37.09™-1999 (R2007) (Revision of IEEE Std C37.09-1979)	
Elektrotechnik	ANSI C37.54- 2002 March 2003	American National Standard For Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear— Conformance Test Procedures	
Elektrotechnik	ANSI C37.20.2-2015	IEEE Standard for Metal-Clad Switchgear	
Elektrotechnik	ANSI C37.20.7-2007	IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults	
Elektrotechnik	ANSI C37.122.2- 2011	IEEE Guide for the Application of Gas Insulated Substations 1kV to 52kV	
Elektrotechnik	IEEE Std C57.13-2008	IEEE Standard Requirements for Instrument Transformers	

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Elektrotechnik	E DIN EN 61180 VDE 0432-10 Juli 2013	Hochspannungs-Prüftechnik für Niederspannungsgeräte Begriffe, Prüfung und Prüfbedingungen, Prüfgeräte	
	DIN EN 61180-1 VDE 0432-10 Mai 1995	Hochspannungs-Prüftechnik für Niederspannungsgeräte Begriffe, Prüfung und Prüfbedingungen (IEC 61180-1:1992); Deutsche Fassung EN 61180-1:1994	
	IEC 61180-1 Edition 1.0, 1992-10	High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements (IEC 61180-1:1992); German version EN 61180-1:1994	
	DIN EN 61180-2 VDE 0432-11 Mai 1995	Hochspannungs-Prüftechnik für Niederspannungsgeräte Prüfgeräte (IEC 61180-2:1994); Deutsche Fassung EN 61180-2:1994	
	IEC 61180-2 Edition 1.0, 1994-06	High-voltage test techniques for low-voltage equipment – Part 2: Test equipment (IEC 61180-2:1994); German version EN 61180-2:1994	

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Elektrotechnik	DIN EN 61439-1 VDE 0660-600-1 Juni 2012 +	Niederspannungs-Schaltgerätekombinationen Teil 1: Allgemeine Festlegungen (IEC 61439-1:2011); Deutsche Fassung EN 61439-1:2011	
	DIN EN 61439-1 Bbl 1 VDE 0660-600-1 Bbl 1 Berichtigung 1 Dezember 2014 +	Berichtigung zu DIN EN 61439-1 Beiblatt 1 (VDE 0660-600-1 Beiblatt 1):2014-06	
	DIN EN 61439-1 VDE 0660-600-1 Beiblatt 1: Juni 2014	Niederspannungs-Schaltgerätekombinationen Teil 1: Allgemeine Festlegungen; Beiblatt 1: Leitfaden für die Spezifikation von Schaltgerätekombinationen (IEC/TR 61439-0:2013)	
	IEC 61439-1 Edition 2.0, 2011-08	Low-voltage switchgear and controlgear assemblies – Part 1: General rules (IEC 61439-1:2011); German version EN 61439-1:2011	
	IEC/TR 61439-0 Edition 2.0, 2013-04	Low-voltage switchgear and controlgear assemblies – Part 0: Guidance to specifying assemblies	
Elektrotechnik	DIN EN 61439-2 VDE 0660-600-2 Juni 2012	Niederspannungs-Schaltgerätekombinationen Teil 2: Energie-Schaltgerätekombinationen (IEC 61439-2:2011); Deutsche Fassung EN 61439-2:2011	
	IEC 61439-1 Edition 2.0, 2011-08	Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies (IEC 61439-2:2011); German version EN 61439-2:2011	

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Elektrotechnik	DIN EN 61439-3 VDE 0660-600-3 Februar 2013 +	Niederspannungs-Schaltgerätekombinationen Teil 3: Installationsverteiler für die Bedienung durch Laien (DBO) (IEC 61439-3:2012); Deutsche Fassung EN 61439-3:2012	
	DIN EN 61439-3 VDE 0660-600-3 Berichtigung 1 Oktober 2014	Berichtigung zu DIN EN 61439-3 (VDE 0660-600-3):2013-02; (IEC-Cor.:2013 zu IEC 61439-3:2012)	
	IEC 61439-3 Edition 1.0, 2012-02	Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO) (IEC 61439-3:2012); German version EN 61439-3:2012	
Elektrotechnik	DIN EN 61439-4 VDE 0660-600-4 September 2013	Niederspannungs-Schaltgerätekombinationen Teil 4: Besondere Anforderungen für Baustromverteiler (BV) (IEC 61439-4:2012); Deutsche Fassung EN 61439-4:2013	
	IEC 61439-4 Edition 1.0, 2012-11	Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS) (IEC 61439-4:2012); German version EN 61439-4:2013	

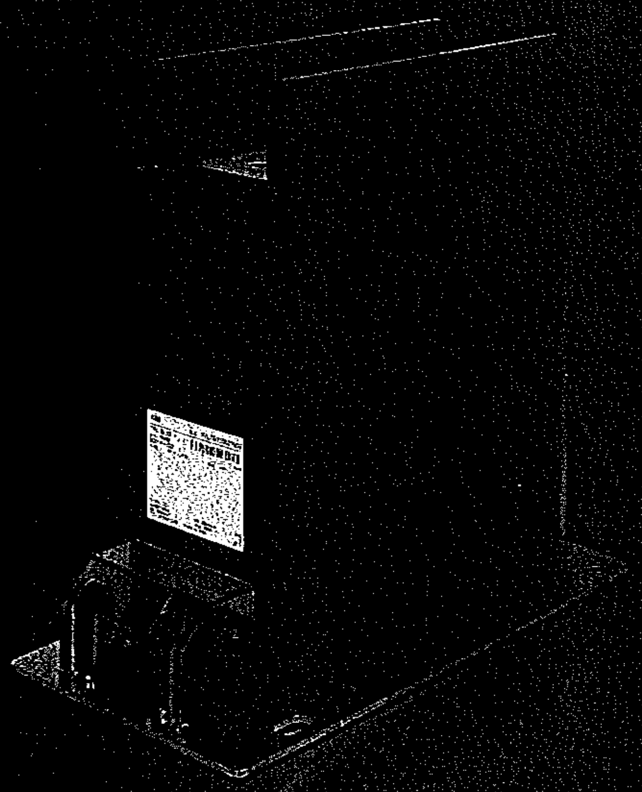
ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-5 VDE 0660-600-5 Oktober 2011	Niederspannungs-Schaltgerätekombinationen Teil 5: Schaltgerätekombinationen in öffentlichen Energieverteilungsnetzen (IEC 61439-5:2010); Deutsche Fassung EN 61439-5:2011	
	E DIN EN 61439-5 VDE 0660-600-5 Juli 2014	Niederspannungs-Schaltgerätekombinationen Teil 5: Schaltgerätekombinationen in öffentlichen Energieverteilungsnetzen (IEC 17D/492/CDV:2013); Deutsche Fassung FprEN 61439-5:2013	
	IEC 61439-5 Edition 2.0, 2014-08	Low-voltage switchgear and controlgear assemblies - Part 5: Assemblies for power distribution in public networks (IEC 61439-5:2014);	
Elektrotechnik	DIN EN 60439-1 VDE 0660-500 Beiblatt 2 Mai 2009	Niederspannungs-Schaltgerätekombinationen Teil 1: Typgeprüfte und partiell typgeprüfte Kombinationen – Technischer Bericht: Verfahren für die Prüfung unter Störlichtbogenbedingungen (IEC/TR 61641:2008)	
	IEC TR 61641 Edition 3.0, 2014-09	Enclosed low-voltage switchgear and controlgear assemblies – Guide for testing under conditions of arcing due to internal fault	

ВЯРНО С ОРИГИНАЛА

Приложение 2.1 - Каталог на TPU 6x.xx

ВЯРНО С ОРИГИНАЛА



Medium Voltage Product

TPU 6x.xx
Indoor supporting current transformers

ВЯРНО С ОРИГИНАЛА

Power and productivity
for a better world™

ABB

Technical parameters	Value
Highest voltage for equipment	24 up to 25 kV
Power frequency test voltage, 1 min.	50 up to 55 kV
Lighting impulse test voltage	up to 125 kV
Rated primary current	10 - 3 200 A
Rated short-time thermal current	2 - 100...1s kA
Burdens, classes	5-30/0.2-5/5P; 10P VA/cl (acc. to other param. - Ith)
Reconnectable (primary till 400-800 A)	primary or secondary

Description

The TPU 6x.xx transformers are cast in epoxy resin and designed for insulation voltages up to 25 kV. The 24 kV version has the same dimensions as the 25 kV. For certain types of panels there is a need for extra long creepage distance on the transformers. For this purpose you can order current transformers with „ribs on the top". The transformers are manufactured in conformity with dimensions stated hereunder. The TPU 6x.xx transformers are designed as single-turn or multi-turn versions, with one transformer ratio or with double ratio having the possibility to be reconnectable on the primary or on the secondary side. The number of secondary windings (from 1 to 6 – max. 12 secondary terminals - 2 rows), depends on the combination of the technical parameters (such as the accuracy class, burden, short-circuit current, overcurrent factor...) and the transformer dimensions size.

When agreed between the manufacturer and the customer the TPU transformers can be provided with the voltage indication system. For this purpose, however, it is necessary to know in what insulation level the transformers shall operate. The secondary windings are used for measurement or protection purposes, or for special use (testing winding, „X" class windings). One terminal of each secondary winding used and one terminal of short-circuited and not used winding have to be earthed during the transformer operation. The secondary windings are lead out into a cast-type secondary terminal box with plastic cover. The terminal cover is sealable. The terminals are provided with M5 screws for the termination and with throughgoing holes for direct earting (first row of secondary terminals).

Technical data

The transformer can be mounted in any position. The transformer body is fixed by using four screws. Earth clamp M8 is on the transformer base plate.

Rated primary voltages
24 kV; 25 kV

Rated primary currents
10; 15; 20; 25; 30; 40; 50; 60; 75; 100; 150; 200; 300; 400; 500; 600; 750; 1 000; 1 250; 1 500; 2 000; 2 500; 3 000 and 3 200 A; primary reconnectable modification max till 400-800 A. Other primary currents can also be agreed upon with the customer.

Rated secondary currents
5 A; 1 A, others on request (possibility to combine different values in one transformer)

Accuracy classes
0.2; 0.2S; 0.5; 0.5S; 1; 3; 5; 5P10; 5P15; 5P20; 10P10; 10P15; 10P20; others on request.

Rated frequency
50 Hz or 60 Hz, others on request

The transformers are designed and manufactured in conformity with the following standards and recommendations: IEC, VDE, ANSI, BS, GOST and CSN, others on request.

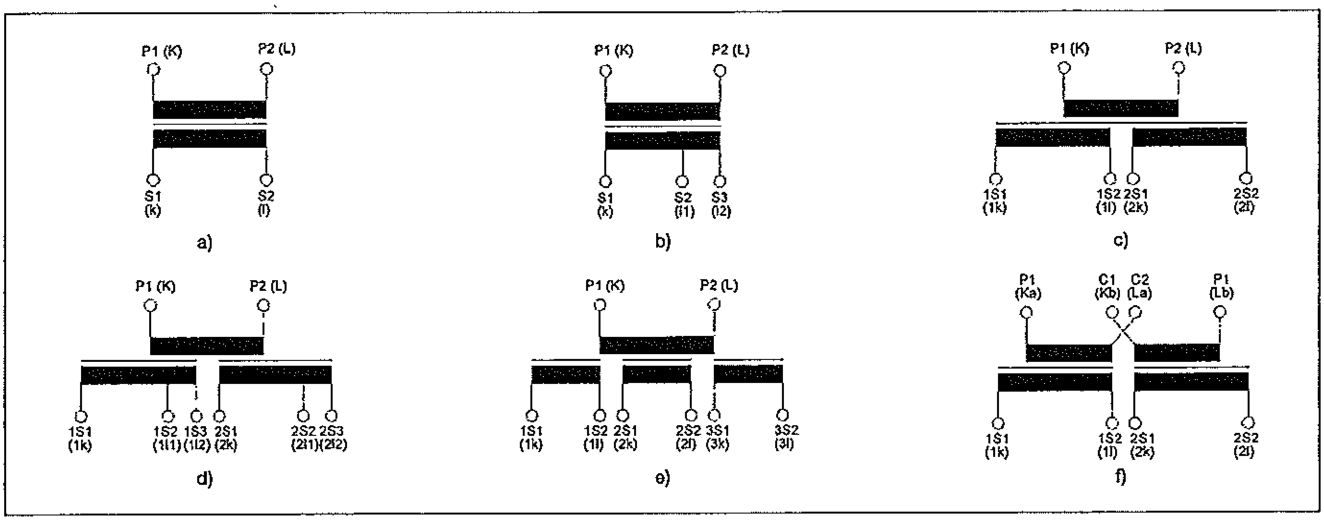
Cantilever strength
5 kN

Permissable torques for screw connections		
M5	max 3.5 Nm	min 2.8 Nm
M8	max 20 Nm	min 16 Nm
M12	max 70 Nm	min 56 Nm

Code designation - TPU current transformers

TPU	4	x	.	x	x
	voltage	current		dimension	primary terminals
	6....up to 25 kV	0... to 600 A multiturn 3...to 1 250 A singleturn 4...to 1 500 A singleturn 5...to 2 000 A singleturn 6...to 2 500 A singleturn 7...to 3 000 A singleturn 8...to 3 200 A singleturn		1..short 178 mm, DIN 2..long 178 mm, DIN	1..no pr.rec., no ribs /40x80mm, 80x80mm/ 2..prim. rec., no ribs /40x80mm, 80x80mm/ 3..no pr.rec., with ribs /60x68mm, 80x80mm/ 4..prim. rec., with ribs /40x80mm, 80x80mm/ 5..no pr.rec., with ribs /40x80mm, 80x80mm/

Marking of current transformer outlets - example



a) Single-core design | b) Double-core design | c) Three-core design | d) Single-core design, reconnectable on the secondary side | e) Double-core design, reconnectable on the secondary side | f) Double-core design, reconnectable on the primary side

Standartized insulation levels of TPU 6x.xx transformers

24/50/125 kV
25/50/125 kV
25/55/125 kV

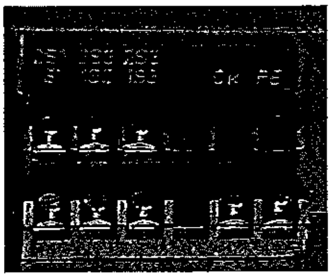


Fig. 1. 1 Secondary terminal box
(3 secondaries and voltage indicator)

Fig. 2. 2 Secondary terminal box
(2 secondaries and grounding screw)

ВЯРНО С ОРИГИНАЛА

Standartized transformers

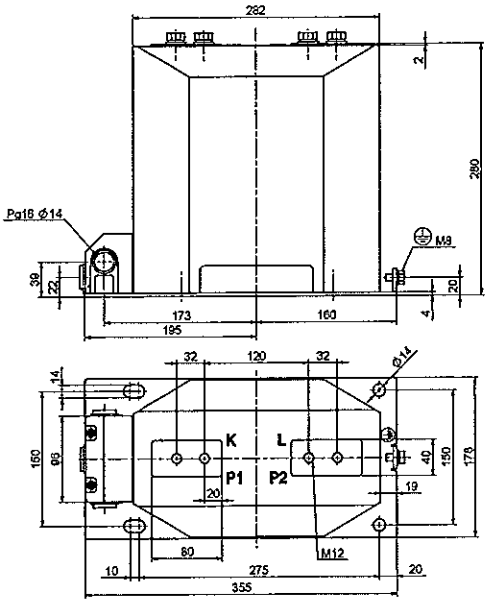
Type	Ithn/dyn [kA]	Ratio [A]	Burden [VA]	Class	FS/ALF
60.11	6.3/16	20//5	10	5P	15
60.11	6.3/16	20//5	20	5P	10
60.11	6.3/16	20//5/5	15/15	0.5/5P	FS5/10
60.11	12.5/31.5	20//5	10	5P	15
60.21	12.5/31.5	20//5/5	15/15	0.5/5P	FS5/5
60.21	16/40	20//5	15	5P	15
60.21	16/40	20//5/5	10/10	0.5/10P	FS5/10
60.11	6.3/16	30//5	15	5P	15
60.11	6.3/16	30//5	20	5P	10
60.11	6.3/16	30//5/5	15/15	0.5/5P	FS5/15
60.11	12.5/31.5	30//5	10	5P	15
60.11	12.5/31.5	30//5	20	5P	10
60.21	12.5/31.5	30//5/5	15/15	0.5/5P	FS5/10
60.21	25/63	30//5	10	5P	15
60.21	25/63	30//5	15	5P	10
60.21	25/63	30//5/5	10/10	0.5/5P	FS5/10
60.11	6.3/16	50//5	15	5P	15
60.11	6.3/16	50//5	30	5P	10
60.11	6.3/16	50//5/5	15/15	0.5/5P	FS5/10
60.11	16/40	50//5	10	5P	15
60.11	16/40	50//5	30	5P	10
60.21	16/40	50//5/5	15/15	0.5/5P	FS5/15
60.11	31.5/80	50//5	10	5P	15
60.21	31.5/80	50//5	30	5P	10
60.21	31.5/80	50//5/5	15/15	0.5/5P	FS5/10
60.11	16/40	100//5	15	5P	15
60.11	16/40	100//5/5	15/15	0.5/5P	FS5/15
60.11	31.5/80	100//5	15	5P	15
60.11	31.5/80	100//5/5	15/15	0.5/5P	FS5/10
60.11	31.5/63	200//5	15	5P	15
60.11	31.5/63	200//5	30	5P	15
60.11	31.5/63	200//5/5	15/15	0.5/5P	FS5/15
60.11	40/100	200//5	15	5P	15
60.11	40/100	200//5	30	5P	10
60.11	40/100	200//5/5	15/15	0.5/5P	FS5/10
60.11	31.5/80	300//5	15	5P	15
60.11	31.5/80	300//5	30	5P	10
60.11	31.5/80	300//5/5	15/15	0.5/5P	FS5/15
60.11	50/125	300//5	15	5P	15
60.11	50/125	300//5	30	5P	10
60.11	50/125	300//5/5	15/15	0.5/5P	FS5/15
60.11	40/100	400//5	30	5P	15
60.11	40/100	400//5/5	15/15	0.5/5P	FS5/15
60.11	50/125	400//5	15	5P	15
60.11	50/125	400//5/5	15/15	0.5/5P	FS5/15
60.11	50/125	500//5	30	5P	10
60.11	50/125	500//5/5	15/15	0.5/5P	FS5/15
60.11	50/125	600//5	30	5P	10
60.11	50/125	600//5/5	15/15	0.5/5P	FS10/15
61.11	50/125	400//5	10	5P	15
61.11	50/125	400//5/5	10/10	0.5/5P	FS5/10
62.11	50/125	600//5	15	5P	15
62.11	50/125	600//5	20	5P	10
62.11	50/125	600//5/5	15/15	0.5/5P	FS5/10
63.11	50/125	750//5	15	5P	15
63.11	50/125	750//5	30	5P	10
63.11	50/125	750//5/5	15/15	0.5/5P	FS5/10
63.11	63/160	1 000//5	10	5P	20
63.11	63/160	1 000//5	20	5P	15
63.11	63/160	1 000//5	30	5P	10
63.11	63/160	1 000//5/5	15/15	0.5/5P	FS5/10
63.11	63/160	1 250//5	15	5P	15
63.11	63/160	1 250//5	30	5P	10
63.11	63/160	1 250//5/5	15/15	0.5/5P	FS5/15
64.11	63/160	1 500//5	15	5P	15
64.11	63/160	1 500//5	30	5P	10
64.11	63/160	1 500//5/5	15/15	0.5/5P	FS5/15
65.11	80/200	2 000//5	15	5P	20
65.11	80/200	2 000//5	30	5P	15
65.11	80/200	2 000//5/5	15/15	0.5/5P	FS5/15
66.11	100/250	2 500//5	15	5P	20
66.11	100/250	2 500//5	30	5P	15
66.11	100/250	2 500//5/5	30/30	0.5/5P	FS5/15
67.11	100/250	3 000//5	15	5P	15
67.11	100/250	3 000//5	30	5P	20
67.11	100/250	3 000//5/5	30/30	0.5/5P	FS5/15
68.11	100/250	3 200//5	15	5P	15
68.11	100/250	3 200//5	30	5P	20
68.11	100/250	3 200//5/5	30/30	0.5/5P	FS5/15

ВЯРНО С ОРИГИНАЛА

Dimensional Drawing

TPU 60.11
TPU 63.11

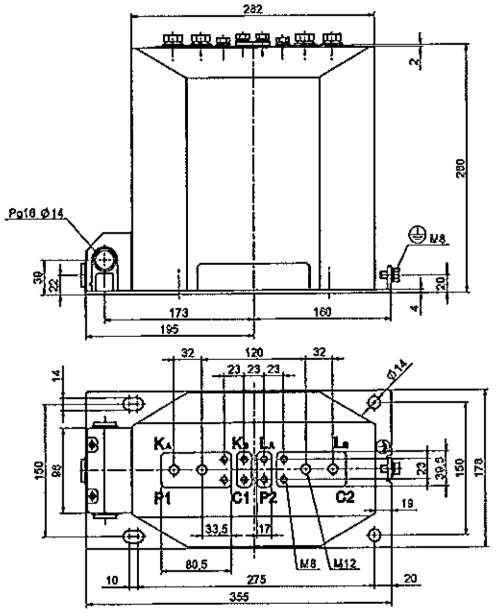
Weight: 31-35 kg
Creepage distance: 270 mm



Drawing n.	Polarity
44615000	P1 to secondary terminal
44615010	P2 to secondary terminal

TPU 60.12

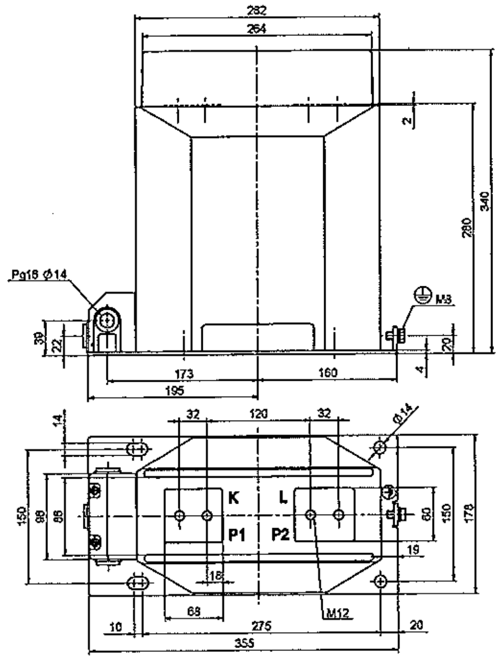
Weight: 31-35 kg
Creepage distance: 282 mm



Drawing n.	Polarity
44615020	P1 to secondary terminal
44615030	P2 to secondary terminal

TPU 60.13
TPU 63.13

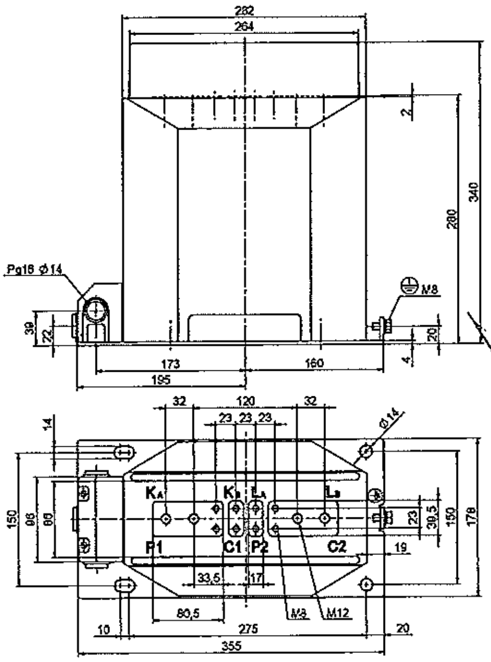
Weight: 31-35 kg
Creepage distance: 280 mm



Drawing n.	Polarity
44615040	P1 to secondary terminal
44615050	P2 to secondary terminal

TPU 60.14

Weight: 31-35 kg
Creepage distance: 282 mm

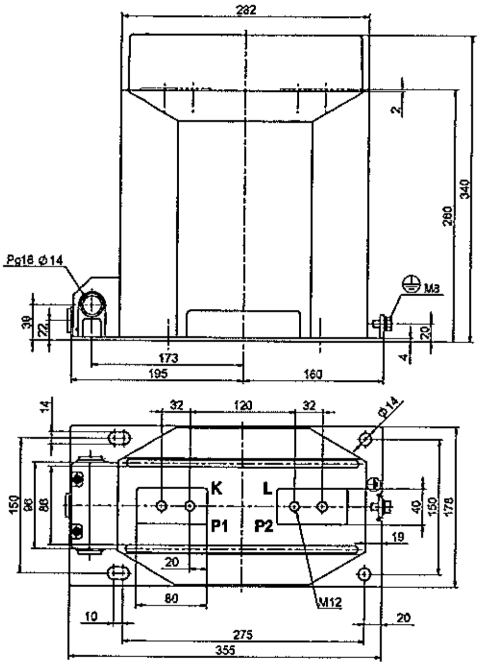


Drawing n.	Polarity
44615060	P1 to secondary terminal
44615070	P2 to secondary terminal

ВЯРНО С ОРИГИНАЛА

TPU 60.15
TPU 63.15

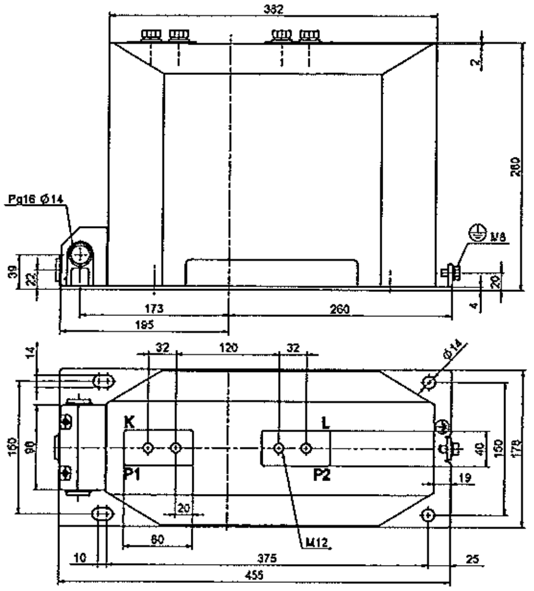
Weight: 31-35 kg
Creepage distance: 280 mm



Drawing n.	Polarity
1VL4600577R0101	P1 to secondary terminal
1VL4600577R0102	P2 to secondary terminal

TPU 60.21
TPU 63.21

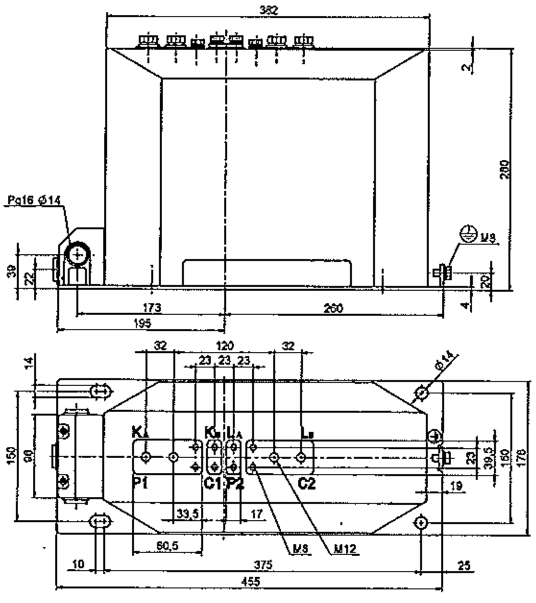
Weight: 43-49 kg
Creepage distance: 270 mm



Drawing n.	Polarity
44615080	P1 to secondary terminal
44615090	P2 to secondary terminal

TPU 60.22

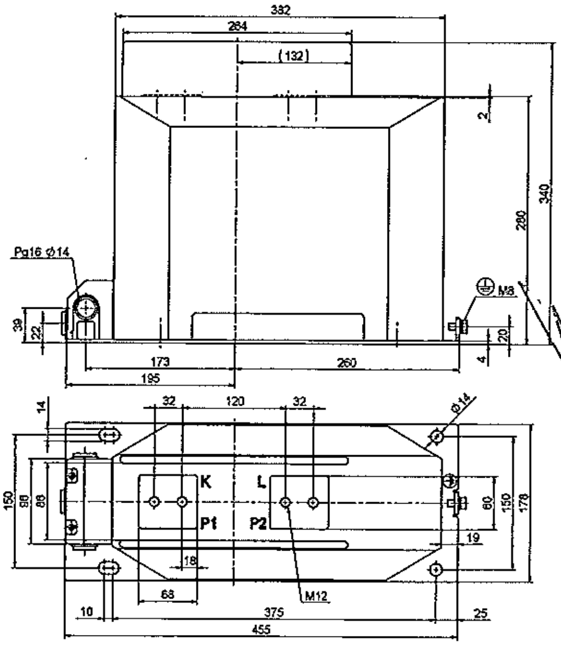
Weight: 43-49 kg
Creepage distance: 282 mm



Drawing n.	Polarity
44615100	P1 to secondary terminal
44615110	P2 to secondary terminal

TPU 60.23
TPU 63.23

Weight: 43-49 kg
Creepage distance: 280 mm

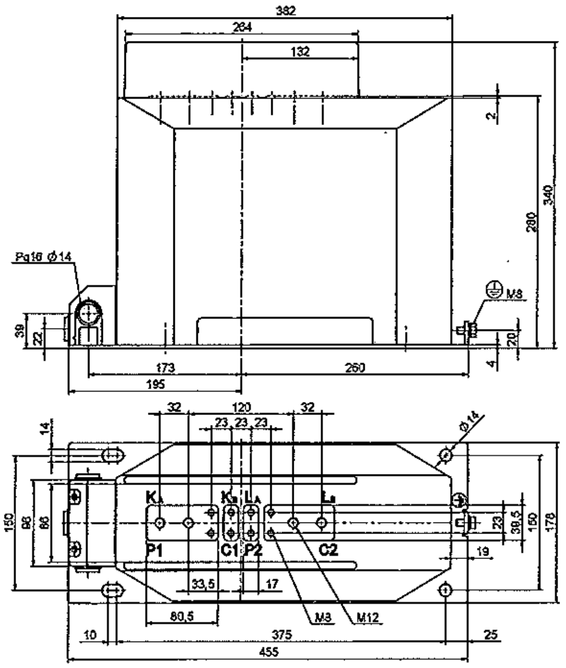


Drawing n.	Polarity
44615120	P1 to secondary terminal
44615130	P2 to secondary terminal

ВЯРНО С ОРИГИНАЛА

TPU 60.24

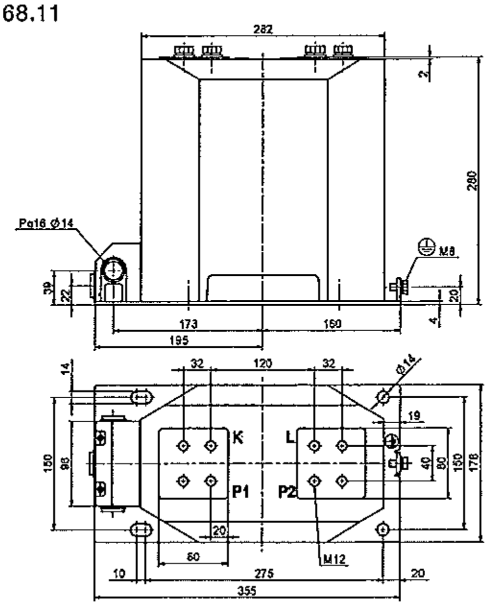
Weight: 43-49 kg
Creepage distance: 282 mm



Drawing n.	Polarity
44615140	P1 to secondary terminal
44615150	P2 to secondary terminal

TPU 64.11
TPU 65.11
TPU 66.11
TPU 67.11
TPU 68.11

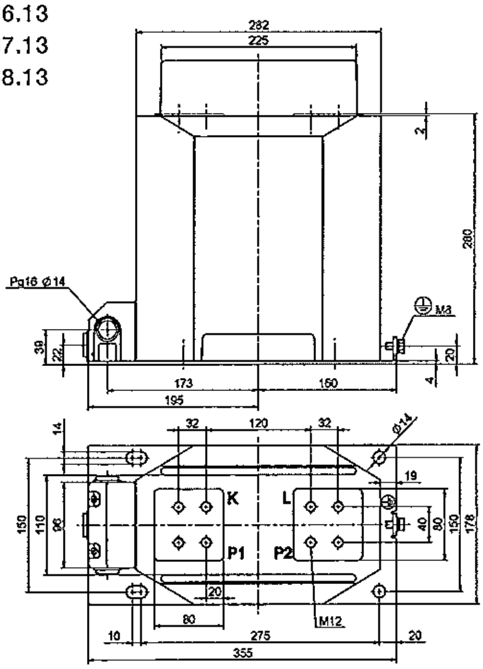
Weight: 36-41 kg
Creepage distance: 270 mm



Drawing n.	Polarity
44615160	P1 to secondary terminal
44615170	P2 to secondary terminal

TPU 64.13
TPU 65.13
TPU 66.13
TPU 67.13
TPU 68.13

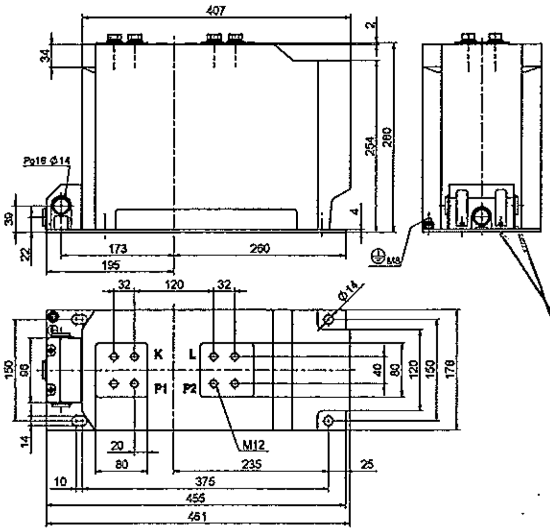
Weight: 36-41 kg
Creepage distance: 270 mm



Drawing n.	Polarity
44615180	P1 to secondary terminal
44615190	P2 to secondary terminal

TPU 64.21
TPU 65.21
TPU 66.21
TPU 67.21
TPU 68.21

Weight: 50-57 kg
Creepage distance: 272 mm

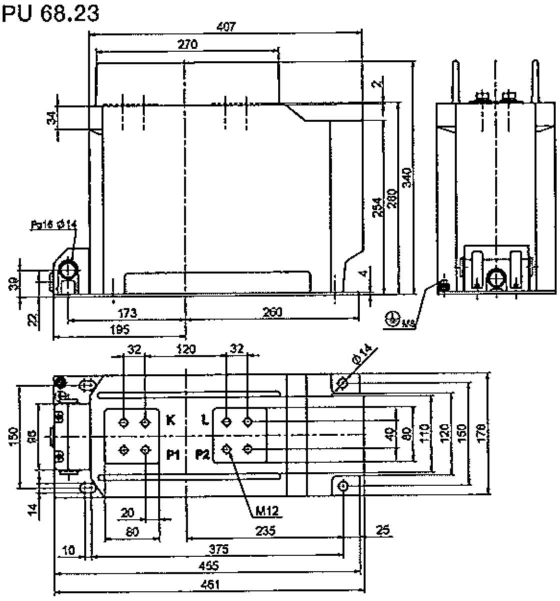


Drawing n.	Polarity
44615200	P1 to secondary terminal
44615210	P2 to secondary terminal

ВЯРНО С ОРИГИНАЛА

TPU 64.23
TPU 65.23
TPU 66.23
TPU 67.23
TPU 68.23

Weight: 50-57 kg
Creepage distance: 272 mm



Drawing n.	Polarity
44615220	P1 to secondary terminal
44615230	P2 to secondary terminal

ВЯРНО С ОРИГИНАЛА

Contact us

ABB s.r.o.
EPMV Brno

Videnska 117, 619 00 Brno,
Czech Republic
Tel.: +420 547 152 021
+420 547 152 614
Fax: +420 547 152 626
E-mail: info.ejf@cz.abb.com

www.abb.com

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Приложение 2.2 - Удостоверение за одобрен тип

ВЯРНО С ОРИГИНАЛА

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология
REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4507.2

КЪМ УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4507

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:* ABB S.r.o., Република Чехия

На основание на: *In Accordance with:* чл. 30, ал.2 от Закона за измерванията

Относно: *In Respect of:* измервателни токови трансформатори за средно напрежение тип TPU xx.xx (TPU 4x.xx, TPU 6x.xx, TPU 7x.xx)

Технически и метрологични характеристики: *Technical and metrological characteristics*: приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване

Срок на валидност: *Valid until:* 14.09.2025 г.

Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:* 4507

Дата на издаване на първоначалното удостоверението за одобрен тип: *Date:* 05.01.2006 г.

Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:* 14.09.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

ВЯРНО С ОРИГИНАЛА

Приложение към Допълнение № 15.09.4507.2 към удостоверение № 06.01.4507

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателни токови трансформатори за средно напрежение тип TPU xx.xx (TPU 4x.xx, TPU 6x.xx, TPU 7x.xx)

Описание на допълнение № 15.09.4507.2 към удостоверение за одобрен тип № 06.01.4507

Издаденото допълнение № 15.09.4507.2 към удостоверение за одобрен тип № 06.01.4507 е за удължаване на срока на валидност на одобряване на типа до 14.09.2025 година.

ВЯРНО С ОРИГИНАЛА

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4507.1

КЪМ УДОСТОВЕРЕНИЕ ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4507

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ABB S.r.o., Република Чехия
На основание на: *In Accordance with:*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)
Относно: *In Respect of:*	измервателни токови трансформатори за средно напрежение тип TPU xx.xx
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	05.01.2016 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4507
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	03.09.2015 г.

ПРЕДСЕДАТЕЛ:

доц. д-р Димитър Станков

ВЯРНО С ОРИГИНАЛА

Приложение към Допълнение № 15.09.4507.1 към удостоверение № 06.01.4507

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателни токови трансформатори за средно напрежение тип TPU xx.xx

Описание на допълнението към удостоверение за одобрен тип № 06.01.4507

В **т. 1.1. Технически и метрологични характеристики** да се допълни:

- Номинални първични токове:
  - за TPU 4x.xx: от 10 А до 3200 А;
  - за TPU 6x.xx: от 10 А до 3200 А;
  - за TPU 7x.xx: от 10 А до 2500 А.

В **т. 1.3. Схеми на местата за поставяне на знаци, удостоверяващи резултатите от контрола и места за пломбиране** да се допълни:

- Знакът за одобрен тип ще бъде гравиран на табелата с номинални данни от завода производител;
- Знакът за първоначална проверка (марка за залепване) се поставя до гравирания знак за одобрен тип.

ВЯРНО С ОРИГИНАЛА

Приложение 2.3 - Типови изпитания

ВЯРНО С ОРИГИНАЛА

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE
HOCHLEISTUNGSPRÜFUNGEN
Member of the
SHORT-CIRCUIT TESTING LIAISON (STL)

Certificate No. 14241Ra

Copy No. 1

TYPE TEST CERTIFICATE OF COMPLETE TYPE TEST

APPARATUS:	Current transformer
DESIGNATION:	TPU 60.11 Rated voltage: 24 kV Rated normal current: 600 A Rated frequency: 50 Hz
SERIAL NUMBER:	1VLT5114049944
MANUFACTURER:	ABB s.r.o., PPMV, Brno, Czech Republic under license of ABB Technology Ltd., Zurich, Switzerland
TESTED FOR:	ABB Technology Ltd., Zurich, Switzerland
DATE(S) OF TEST:	22nd October and 04th, 19th and 20th November 2014
TESTED BY:	PEHLA-Testing Laboratory Ratingen, Germany ABB s.r.o. Laboratory Brno, Czech Republic on behalf of PEHLA-Testing Laboratory Ratingen, Germany

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with

IEC 61869-1, Ed. 1.0, 2007-10, cl. 7.3.2, 7.3.3, 7.3.4, 7.3.6
IEC 61869-2, Ed. 1.0, 2012-09, cl. 7.2.2, 7.2.3, 7.2.6.201 - 203, 7.2.201, 7.3.1, 7.3.5.201 - 203, 7.3.201, 7.3.203 and 204, 7.5.2

This Type Test Certificate has been issued by PEHLA following exclusively the STL Guides.

The results are shown in the record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performances are considered to comply with the above Standard(s) and to justify the ratings assigned by the manufacturer as listed on page No. 7.

The Certificate applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

This Certificate comprises 34 sheets in total.

The authenticity of this document is guaranteed by the integrity of the seal label and seal ribbon. Without a written permission of PEHLA it is not allowed to make reproduction in extracts of this document. Copying the cover sheet accompanied by sheet 2 and the sheets mentioned here is an exception.

GESELLSCHAFT FÜR ELEKTRISCHE
HOCHLEISTUNGSPRÜFUNGEN

Wollinger
M. Wollinger

Management Committee

H. Spitzer
Dr. T. Ebke

Technical Committee

Mannheim, 21st January 2015

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12072-06-01

ВЯРНО С ОРИГИНАЛА

Notes

Accreditation

The PEHLA GbR, PEHLA-Testing Laboratory Ratingen has been approved by the DAkkS (German Accreditation Body) according to EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. D-PL-12072-06-01).

STL-Member

PEHLA is founder member of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (UK), CESI (IT), CPRI (IND), ESEF (FR), KEMA (NL), KERI (KR), SATS (NO, SE, FI), STLNA (US, CA) and JSTC (JP). In the frame-work of EC, STL (EU) has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Type Test Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

A Test Confirmation

is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.

Uncertainty of the measurement systems

The PEHLA - Testing Laboratories apply the PEHLA Guide No. 12 for determining the uncertainties of measurement, based on ENV 13005 (Guide to the expression of uncertainty in measurement). As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.

Addresses

Office:
PEHLA-Geschäftsstelle
Hallenweg 40
68219 Mannheim
Germany
Internet: www.pehla.com

Client:
ABB AG
Kallstadter Str. 1
68309 Mannheim
Germany
as shareholder and contractor of PEHLA GbR

Testing Station:
PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen
Germany

ABB s.r.o. Laboratory
Vídeňská 117
619 00 Brno
Czech Republic
on behalf of PEHLA-Testing Laboratory Ratingen

Manufacturer:
ABB s.r.o.
Vídeňská 117
619 00 Brno
Czech Republic
under license of ABB Technology Ltd. Zurich, Switzerland

Tested for:
ABB Technology Ltd.
Affolternstrasse 44
8050 Zurich,
Switzerland

ВЯРНО С ОРИГИНАЛА

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ВЯРНО С ОРИГИНАЛА

List of Test Participants

Part 1: 22nd October 2014, ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Technical Committee:

Dr. Horst Günther	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Mr. Jiri Zila	ABB s.r.o. Laboratory Brno, Czech Republic
Dr. Otakar Benes	ABB s.r.o. Laboratory Brno, Czech Republic
Mr. Petr Prikryl	ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Client:

Mr. Marcel Jancik	ABB s.r.o. Brno, Czech Republic

Further Participants:

-

List of Test Participants

Part 2: 04th November 2014, PEHLA Testing Laboratory Ratingen, Germany

Representatives of Technical Committee:

Mr. Sebastian Soballa	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Herbert Feld	PEHLA-Testing Laboratory Berlin-Marzahn, Germany

Test Engineer / Test Operator:

Mr. Sebastian Soballa (Test Engineer)	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Frank Idaszeck (Test Operator)	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of Client:

Mr. Marcel Jancik	ABB s.r.o. PPMV, Brno, Czech Republic
Mr. Jiri Zila	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

ВЯРНО С ОРИГИНАЛА

List of Test Participants

Part 3: 19th and 20th November 2014, ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Technical Committee:

Dr. Horst Günther	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Nikolaus Beierlein	PEHLA-Testing Laboratory Regensburg, Germany

Test Engineer / Test Operator:

Mr. Jiri Zila	ABB s.r.o. Laboratory Brno, Czech Republic
Dr. Otakar Benes	ABB s.r.o. Laboratory Brno, Czech Republic
Mr. Petr Prikryl	ABB s.r.o. Laboratory Brno, Czech Republic

Representatives of Client:

Mr. Marcel Jancik	ABB s.r.o. PPMV, Brno, Czech Republic

Further Participants:

-

Technical Data of Test Object
Current Transformer

Test object:	Current transformer
Designation:	TPU 60.11
Manufacturer:	ABB s.r.o., PPMV, Brno, Czech Republic under license of ABB Technology Ltd., Zurich, Switzerland
Serial No.:	1VLT5114049944
Year of manufacture:	2014
Drawing No.:	1VL34610700

Ratings assigned by the manufacturer:

Highest voltage for equipment	24	kV
Rated primary current	600	A
Rated continuous thermal current	120	%
Rated secondary current	1/1	A
Rated frequency	50	Hz
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Duration of short-circuit	1	s
Core 1		
Accuracy class	0.5 FS 5	
Rated burden	15	VA
Core 2		
Accuracy class	5P10	
Rated burden	15	VA
Power-frequency voltage between sections	3	kV
Inter-turn overvoltage	4.5	kV_{peak}
Insulation class	E	
Temperature category	-5/40	

Further data: -

ВЯРНО С ОРИГИНАЛА

List of Identified Drawings

The manufacturer has submitted to the testing laboratory drawings and other data containing sufficient information to unambiguously identify by type the essential details and parts of the test object presented for test.
The drawings have been stamped and signed by the manufacturer in order to guarantee that the drawings or data schedules truly represent the test object to be tested.
Further these drawings have been stamped and signed by PEHLA representatives and are kept

☐ at the client.

☒ with the test documents at the test laboratory.

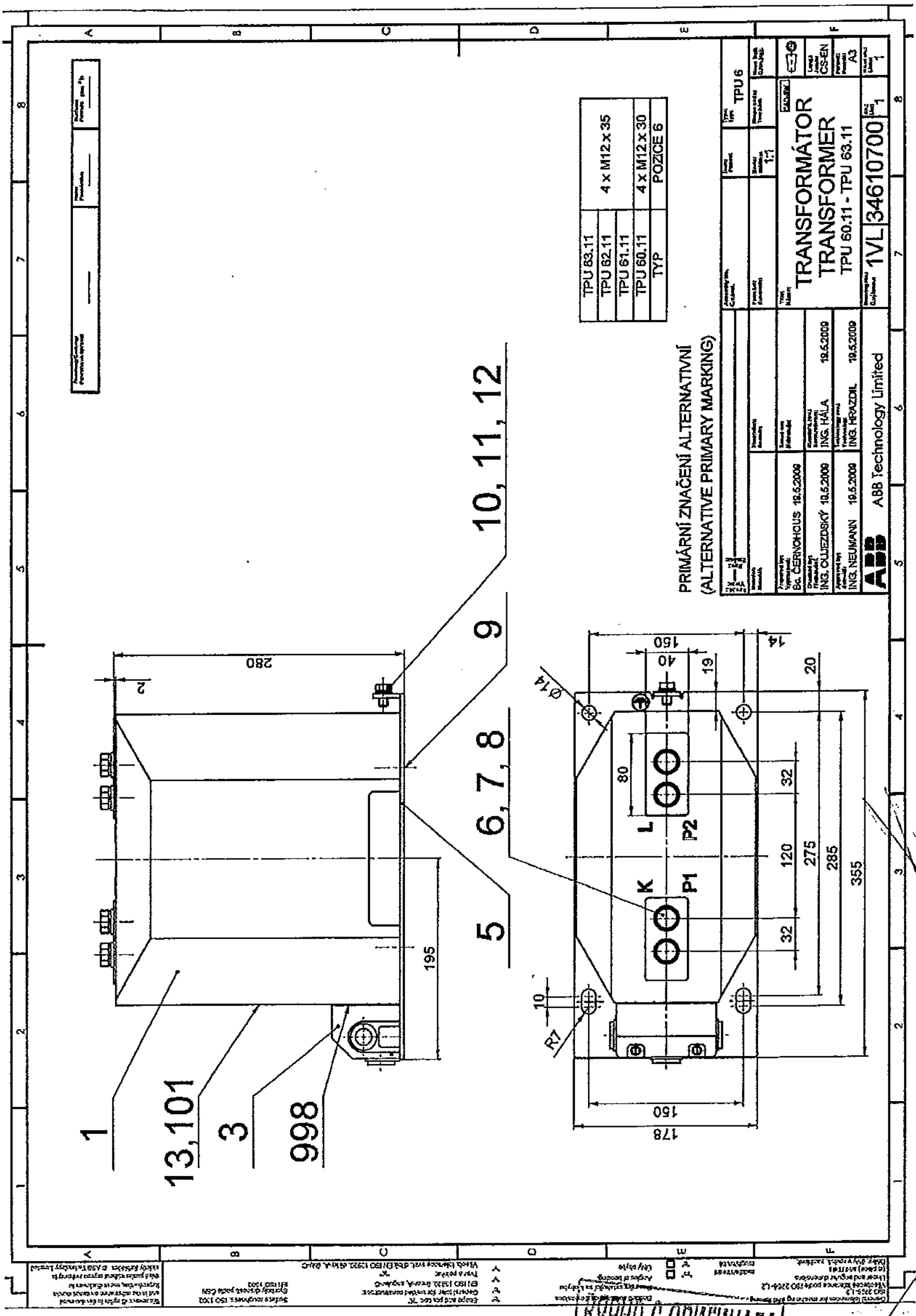
The testing laboratory has checked that drawings and data schedules adequately represent the essential details and parts of the test object to be tested, but is not responsible for the accuracy of the detailed information.
The drawing(s) contained in this document are identical with the checked, stamped and signed drawings.

Drawing No.	Rev.	P/D *)	Title	Additional remarks
1VL34610700	-	D	Transformer TPU 60.11 – TPU 63.11	Included in test report
-	-	P	Transformer TPU 60.11 assembly	-
1VL4600638R0101	-	D	Casting TPU 60.11	-
1VL4600636R0101	-	D	Internal parts TPU 60.11(5)	-
1VL3461099A-100A 34611003	002	D	Positioning plate of TPU	-
1VL3461039A 34610390	-	D	Svorkovnice	-

*) P: Parts list, D: Drawing

ВЯРНО С ОРИГИНАЛА

Drawing No. 1VL34610700
Current Transformer



TPU 63.11	4 x M12 x 35
TPU 62.11	
TPU 61.11	4 x M12 x 30
TPU 60.11	
TYP	POZICE 6

ВЯРНО С ОРИГИНАЛА

Test Results
Accuracy Test

Test performed: Accuracy test
Date of test: 22nd October 2014
Condition of test object: Factory new
Ambient air temperature: 22.7 °C
Humidity: 49.8 %

1. Test performed: **Test for ratio error and phase displacement**

secondary winding 1S1 - 1S2

accuracy class		0.5							
rated current primary / secondary	A	600 / 1							
test current	%	120	100	20	5	120	100	20	5
	A	720	600	120	30	720	600	120	30
rated burden	VA	15							
burden during test	VA	15				3.75			
power factor cosφ		0.8				1.0			
limited ratio error	%	0.500	0.500	0.750	1.500	0.500	0.500	0.750	1.500
limited phase displacement δ	min	30.00	30.00	45.00	90.00	30.00	30.00	45.00	90.00
ratio error	%	0.038	0.007	-0.186	-0.616	0.198	0.192	0.140	-0.010
phase displacement δ	min	1.22	1.86	7.40	17.9	4.63	5.04	9.20	20.6

secondary winding 2S1 - 2S2

accuracy class		5P	
rated current primary / secondary	A	600 / 1	
test current	%	120	100
	A	720	600
rated burden	VA	15	
burden during test	VA	15	
power factor cosφ		0.8	
limited ratio error	%	1.000	
Imited phase displacement δ	min	60.00	
ratio error	%	-0.102	-0.107
phase displacement δ	min	1.58	1.73

Result: Test passed

ВЯРНО С ОРИГИНАЛА

Test Results

Accuracy Test before STC Test (2)

2. Test performed: **Tests for winding resistance (R_{ct}), knee point, security factor and composite error**

2.1 Measuring winding 1S1 – 1S2

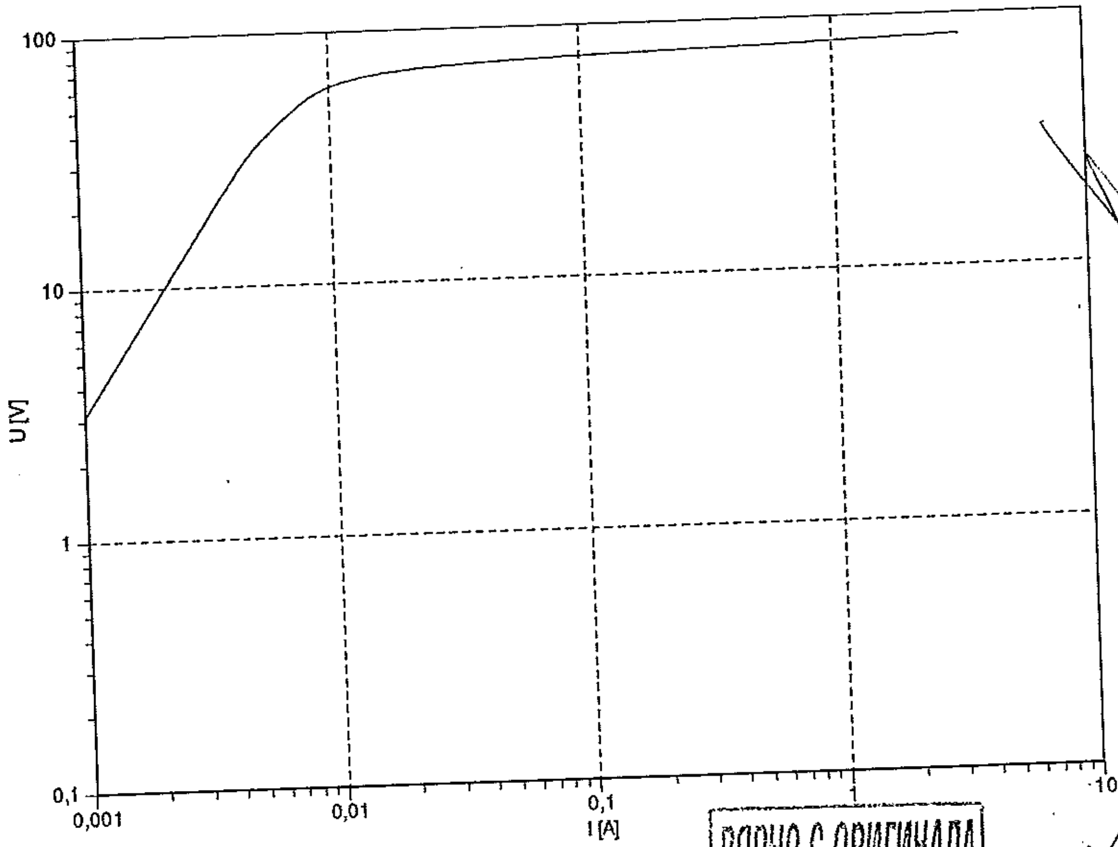
EXCITATION CURVE

RATED DATA

Type	:	TPU 60.11
Serial number	:	1VLT5114049944
Year of production	:	2014
Ratio	:	600//1/1 A
Burden	:	15/15 VA
Accuracy class	:	0,5/5P
Security factor / ALF	:	5/10

MEASURED VALUES

Winding	:	1s1 - 1s2
Resistance of winding (75°C)	:	6,0679 Ohm
Security factor e->n	:	4,11
Knee point U / I	:	61,59 V / 0,0112 A



ВЯРНО С ОРИГИНАЛА

Test Results

Accuracy Test before STC Test (3)

2.2 Measuring winding 2S1 – 2S2

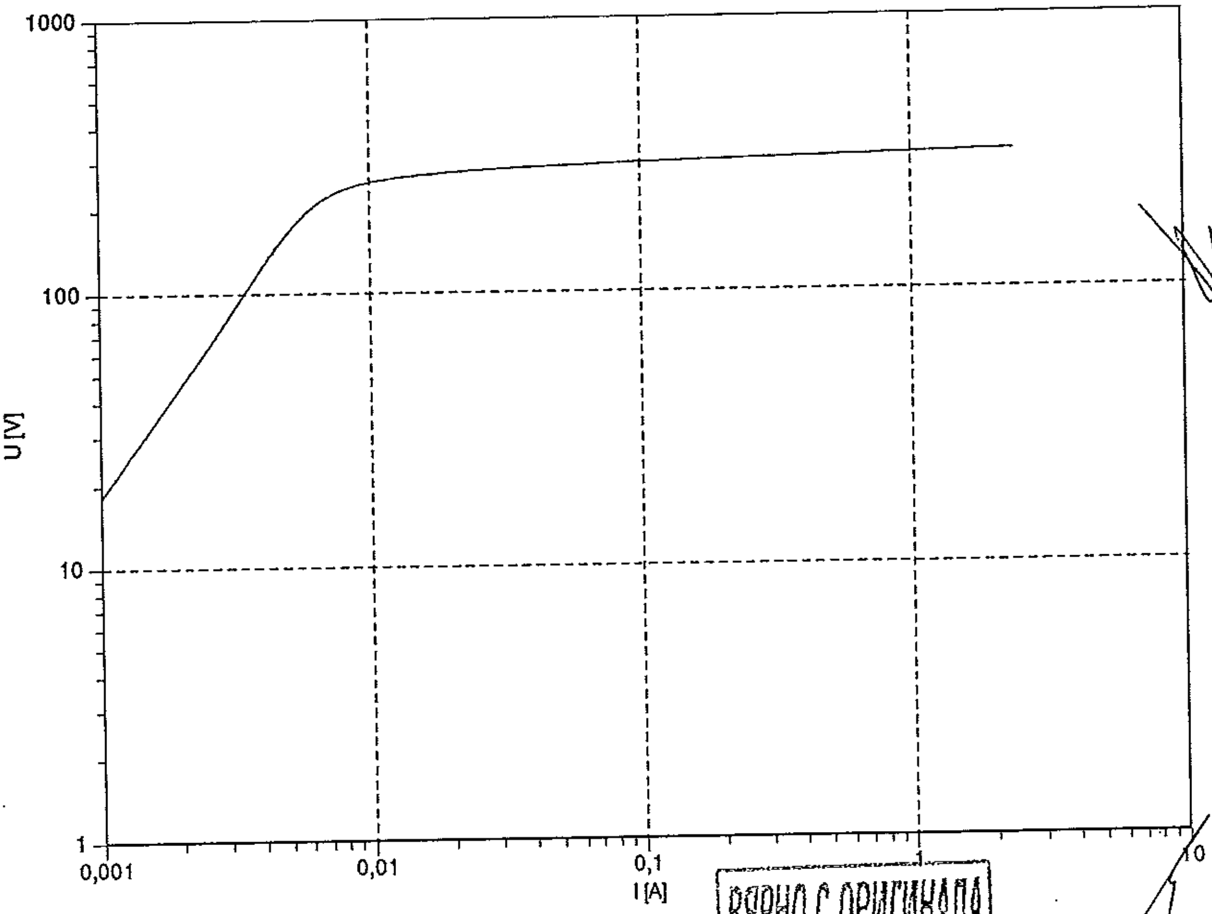
EXCITATION CURVE

RATED DATA

Type	: TPU 60.11
Serial number	: 1VLT5114049944
Year of production	: 2014
Ratio	: 600//1/1 A
Burden	: 15/15 VA
Accuracy class	: 0,5/5P
Security factor / ALF	: 5/10

MEASURED VALUES

Winding	: 2s1 - 2s2
Resistance of winding (75°C)	: 9,2195 Ohm
Security factor e->n	: 13,87
Composite error	: 0,1 %
Knee point U / I	: 239,99 V / 0,0087 A



ВЯРНО С ОРИГИНАЛА

Test Results

Power-Frequency Voltage Withstand Test on Secondary Terminals

Test performed:	Power-frequency voltage withstand test on secondary terminals
Date of test:	22nd October 2014
Condition of test object:	As after previous accuracy test
Ambient air temperature:	22.7 °C
Humidity:	49.8 %

- The test voltage of 3 kV, 50 Hz was applied for 60 s in turn between the short circuited terminals of each winding and earth. The frame F and all the other terminals were connected to earth.

Voltage applied to winding	Connected to earth	Test voltage / duration	Result
(1S1-1S2)	(2S1-2S2) + F	3 kV / 60 s	passed
(2S1-2S2)	(1S1-1S2) + F	3 kV / 60 s	passed

Result: Test passed

ВЯРНО С ОРИГИНАЛА

Test Results

Inter-Turn Overvoltage Test

Test performed:	Inter-turn overvoltage test
Date of test:	22nd October 2014
Condition of test object:	As after previous accuracy test and power-frequency voltage withstand test on secondary terminals
Ambient air temperature:	22.7 °C
Humidity:	49.8 %

- The primary winding of the current transformer was excited for 60 s with the extended rated current. The secondary winding was open-circuited. The applied current was limited if the voltage of 4.5 kV peak was obtained before reaching the extended rated current.

Tested winding	Test primary current / duration	Voltage at secondary winding	Result
(1S1-1S2)	720 A / 60 s	2.28 kV_{peak}	passed
(2S1-2S2)	720 A / 60 s	3.38 kV_{peak}	passed

Result: Test passed

Test Results

Verification of Markings

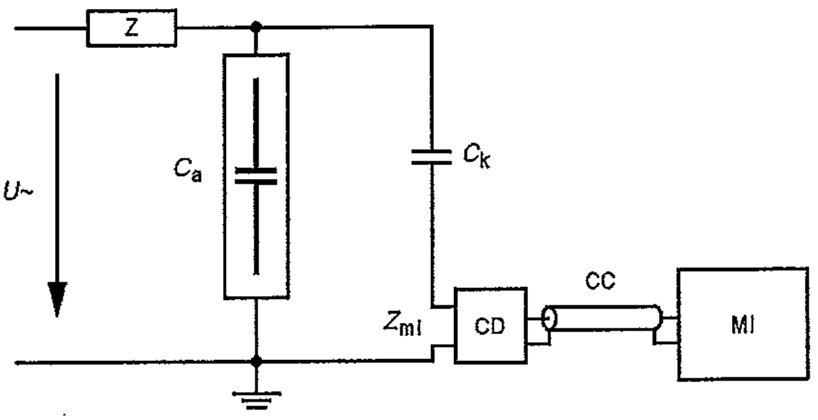
Test performed:	Verification of markings
Date of test:	22nd October 2014
Condition of test object:	As after previous accuracy test, power-frequency voltage withstand test on secondary terminals and inter-turn overvoltage test

Result: The terminal markings of the test object are verified to be correct in accordance with the requirements of the applied test specifications.

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuit

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement



Technical Data:

High voltage supply:

Frequency Inverter, Type SL 11000-3, ZSE Praha, serial No. 3400497

Motor frequency:	Selectable range up to 220 Hz

U ~ High Voltage Test Transformer type T100, HIGH VOLT Prüftechnik Dresden GmbH
serial No. 885168

Primary voltage	230	V
Rated voltage	100	kV
Rated power	6.6	kVA

100 kV Alternating Voltage Measuring system WGBS 11/100-135, HIGH VOLT Prüftechnik Dresden GmbH, serial No. 884900, consisting of:

100 kV voltage measuring capacitor, type CDCT 0615B12, serial No.0521589-10001
Low voltage measuring part, Type MC 20-4, serial No. 885172
Peak voltmeter, type MU 18, serial No. 885173

C_a	Test object
Z	Filter 40 mH
Z_{mi}	Input impedance of measuring system 50 Ω
CC	Connecting coaxial cable, type L34/10 (50 Ω, length 10 m)
C_k	Coupling capacitor 100 kV / 1nF
CD	Coupling device
MI	Measuring instrument system

Tolerances: According to the IEC 60060-2 cl. 7.1.1 the limits of the measurement uncertainly amount are 3% for the $U_{peak} / \sqrt{2}$

Test Procedure

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement

The power-frequency withstand test on primary terminal and the partial discharge measurement (routine tests) were performed before and after lightning impulse voltage test, temperature-rise test and the short circuit withstand capability test (type tests).

The PD measurements were performed in accordance with IEC61869-1, Ed. 1.0, 2007-10 clause 7.3.2.2 procedure A. Procedure A means the partial discharge test voltages are reched while decreasing the voltage after the power-frequency withstand test. The corresponding partial discharge levels are measured in a time within 30 s.

Calibration:
Before starting the PD measurements the PD test circuit was calibrated in the actual test arrangement.

PD test procedure:
After the power-frequency voltage was applied the voltage is decreased without interruption to 1.2 U_m and the PD level is measured in a time of 30 s. After that the voltage is decreased without interruption furthermore to 1.2 $U_m/\sqrt{3}$ and the PD level is measured in a time of 30 s.

Criteria to pass the test:
The maximum permissible partial discharge quantities are specified IEC61869-1, Ed. 1.0, 2007-10 clause 5.3.3.1 as follows:

at 1.2 x U_m / PD $\leq$ 50 pC
at 1.2/$\sqrt{3}$ x U_m / PD $\leq$ 20 pC

The measured PD values before type tests are given in the table on sheet 18.
The measured PD values after type tests test are given in the table on sheet 26.

ВЯРНО С ОРИГИНАЛА

Test Results

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement

Test performed:	Power-frequency voltage withstand test on primary terminals and partial discharge measurement
Date of test:	22nd October 2014
Condition of test object:	As after previous accuracy test, power-frequency voltage withstand test on secondary terminals and inter-turn overvoltage test
Test frequency:	50 Hz

Temperature ϑ: 22.7 °C Humidity f: 49.8 % Pressure p: 997 hPa
The atmospheric correction factor was not applied.

Test Arrangement:
See photo at page 32

Test performed: **Power-frequency voltage test**

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage in kV	Test duration / disruptive discharges
Primary terminal	Secondary windings and frame	50	60 s / 0

Test performed: **Partial discharge measurement**

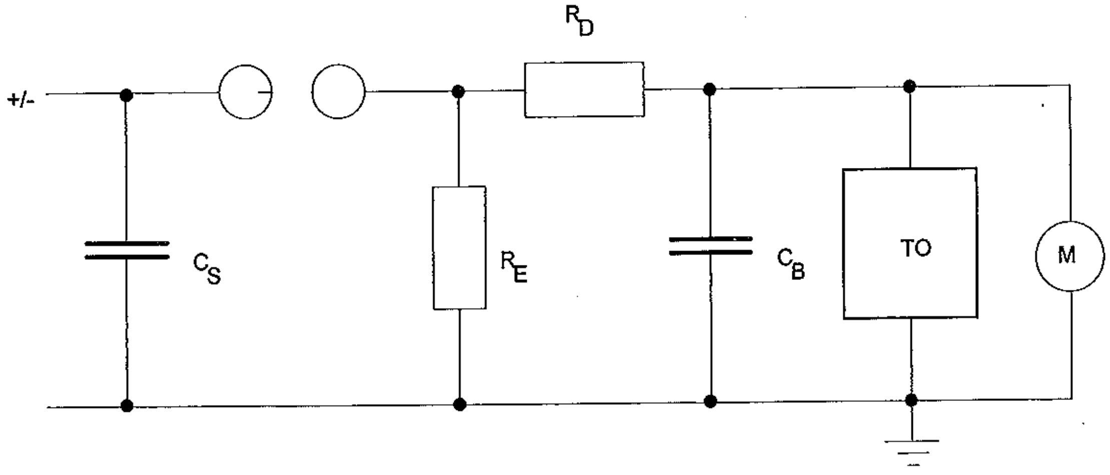
Pre-stress: 50 kV for 60 s
Background noise level: 0.2 pC

Test arrangement		Result	
		Test voltage for 30 s	
Voltage applied to	Earthed	28.8 kV	16.6 kV
		Partial discharge in pC	
Primary terminal	Secondary windings and frame	≤ 0.2	≤ 0.2

Result: Tests passed

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuit
Lightning Impulse Voltage Test on Primary Terminals



Technical Data:

Maximum Charging Voltage	U_Σ	=	400	kV
Number of Stages	n	=	4	
Surge Capacity per Stage	C_S	=	1000	nF
Load Capacitance	C_B	=	2000	pF
Damping Resistance	R_D	=	R_{SI}	
Internal Front Resistance per Stage	R_{SI}	=	43	Ω
Discharge Resistance	R_E	=	4	R_P
Tail Resistance per Stage	R_P	=	66	Ω

TO - Test Object

M - Voltage Measurement

Measurement:

Measuring Divider Type SMC 2000/400 (Serial-No. 885217)

Measuring Cable, Length L35/25 (50 Ω, length 25 m)

Impulse Voltage Measuring System, 25 MHz Digital Recorder, Type TR-AS 25-8 (Serial-No. 247)

Tolerances:

According IEC60060-1 Edition 3.0 2010-09 clause 7.2.2

Test voltage value	± 3	%
Front time T_1	± 30	%
Time to half-value T_2	± 20	%

Test Results
Impulse Voltage Withstand Test on Primary Terminals

Test performed: Lightning impulse voltage test
Date of test: 22nd October 2014
Condition of test object: As after routine tests

Temperature ϑ: 22.7 °C Humidity f: 49.8 % Pressure p: 997 hPa
According to IEC61869-1 cl. 7.2.3.2.1 no correction for atmospheric conditions.

Front time T_1: 1.2 µs Time to half-value T_2: 50 µs

Test arrangement		**Test Voltage**	**Result**
Voltage applied to	Earthed	Lightning impulse voltage kV	number of impulses / disruptive discharges
Primary terminal	Secondary windings and frame	+ 125	15 / 0
		- 125	15 / 0

Result: Test passed

ВЯРНО С ОРИГИНАЛА

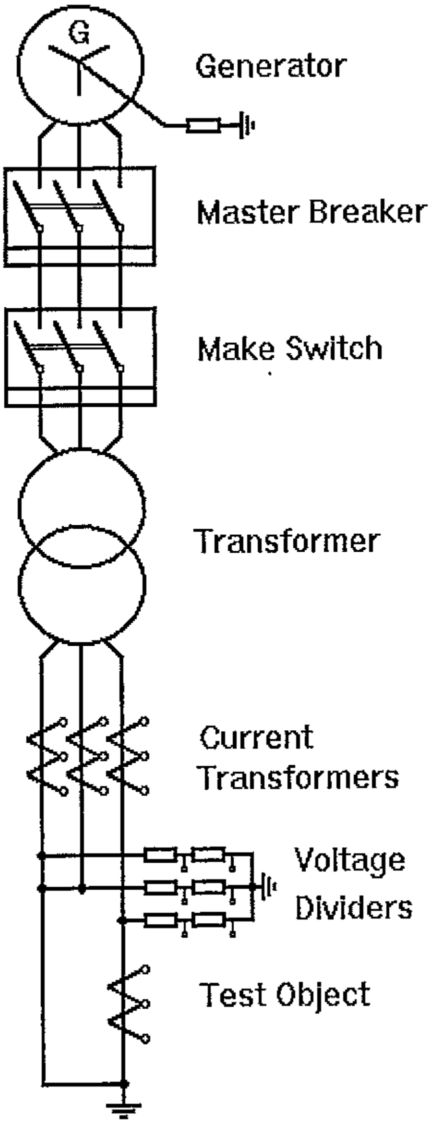
Technical Data of Test Circuit

Short-Time Current Tests

Test performed		STC	-
Test No.	PEHLA 14241Ra /	02 - 05	-
Test circuit			
Circuit diagram	Sheet No.	22	-
Current circuit			
Number of phases		3	-
Power frequency	Hz	50	-
Power factor		< 0.15	-
Earthing conditions			
Generator / System		earthed via 5 kΩ	-
Transformer		not earthed	-
Short-circuit point		earthed	-
Test object		earthed	-
Test object (test values)			
Number of phases		1	-
Measurement			
Voltage measurement		Voltage Dividers 1000 V / 1 V	-
Current measurement		Current Transf. 50 kA / 5 A	-

Remarks: -

Circuit Diagram
Short-Time Current Tests



ВЯРНО С ОРИГИНАЛА

Test Results

Short-Time Current Tests

Test performed: Short-time current tests

Date of test: 04th November 2014

Condition of test object before test: As after routine tests and impulse voltage withstand test

Test arrangement: Direct test circuit.

Connections to test object: Infeed via copper bars with a length of approx. 0.5 m each to the terminals of the current transformer. Secondary windings short-circuited. One side of the infeed and the current transformer earthed via cable.

Gas pressure (abs. rel. to 20 °C): - MPa

Test No.		PEHLA 14241Ra /	03	04	05	-	-	-
Peak withstand current	L1	kA	81.1	54.3	55.9	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Short-circuit current First cycle	L1	kA	34.3	29.9	30.6	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Last cycle	L1	kA	33.6	31.5	35.7	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Equivalent current	L1	kA	33.4	30.2	32.9	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Average value		kA	-	-	-	-	-	-
Duration of short-circuit		s	0.321	1.04	3.10	-	-	-
Short-time withstand current	L1	kA	-	30.9	33.5	-	-	-
	L2	kA	-	-	-	-	-	-
	L3	kA	-	-	-	-	-	-
Average value		kA	-	-	-	-	-	-
Related to rated duration of short-circuit		s	-	1.00	3.00	-	-	-
Duration of short-circuit		s	-	0.96	3.38	-	-	-
Related to rated short-time withstand current		kA	-	31.5	31.5	-	-	-
Emission of flame/gas/oil			no	no	no	-	-	-
Test result (P/N)			P	P	P	-	-	-
Resistance of the main circuit before test	L1	µΩ	-	-	-	-	-	-
Test current: - A (d.c.)	L2	µΩ	-	-	-	-	-	-
	L3	µΩ	-	-	-	-	-	-
Ambient air temperature		°C	-	-	-	-	-	-
Resistance of the main circuit after test	L1	µΩ	-	-	-	-	-	-
Test current: - A (d.c.)	L2	µΩ	-	-	-	-	-	-
	L3	µΩ	-	-	-	-	-	-
Ambient air temperature		°C	-	-	-	-	-	-

Legend: P: Passed in terms of the applied standard N: Not passed in terms of the applied standard

Remarks:

PEHLA 14241Ra / 01:	Current calibration
PEHLA 14241Ra / 02:	Pre-test with reduced values

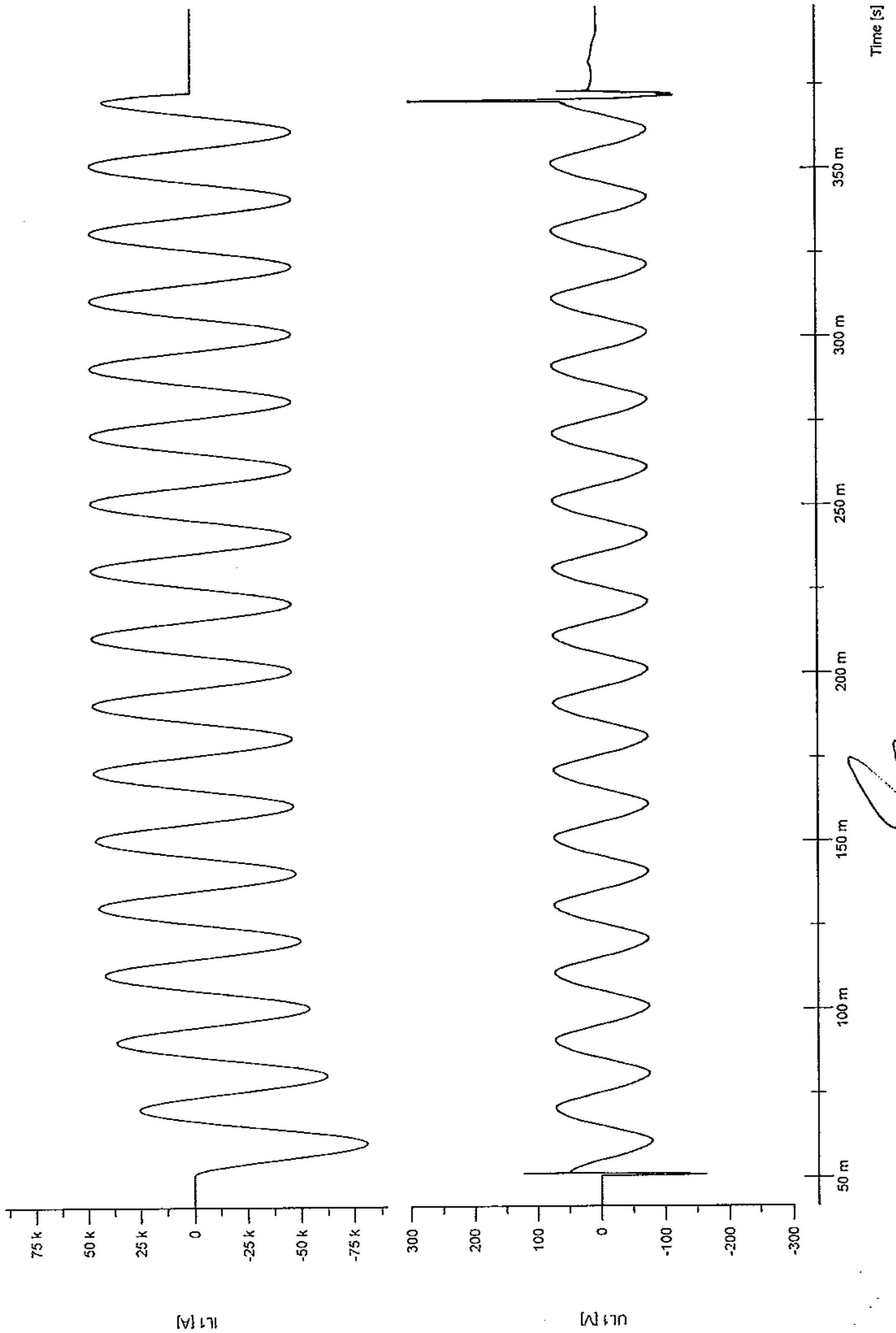
Condition of test object after test: No visible or functional change or damage.

Result: Test passed

ВЯРНО С ОРИГИНАЛА

Oscillogram No. PEHLA 14241Ra / 03

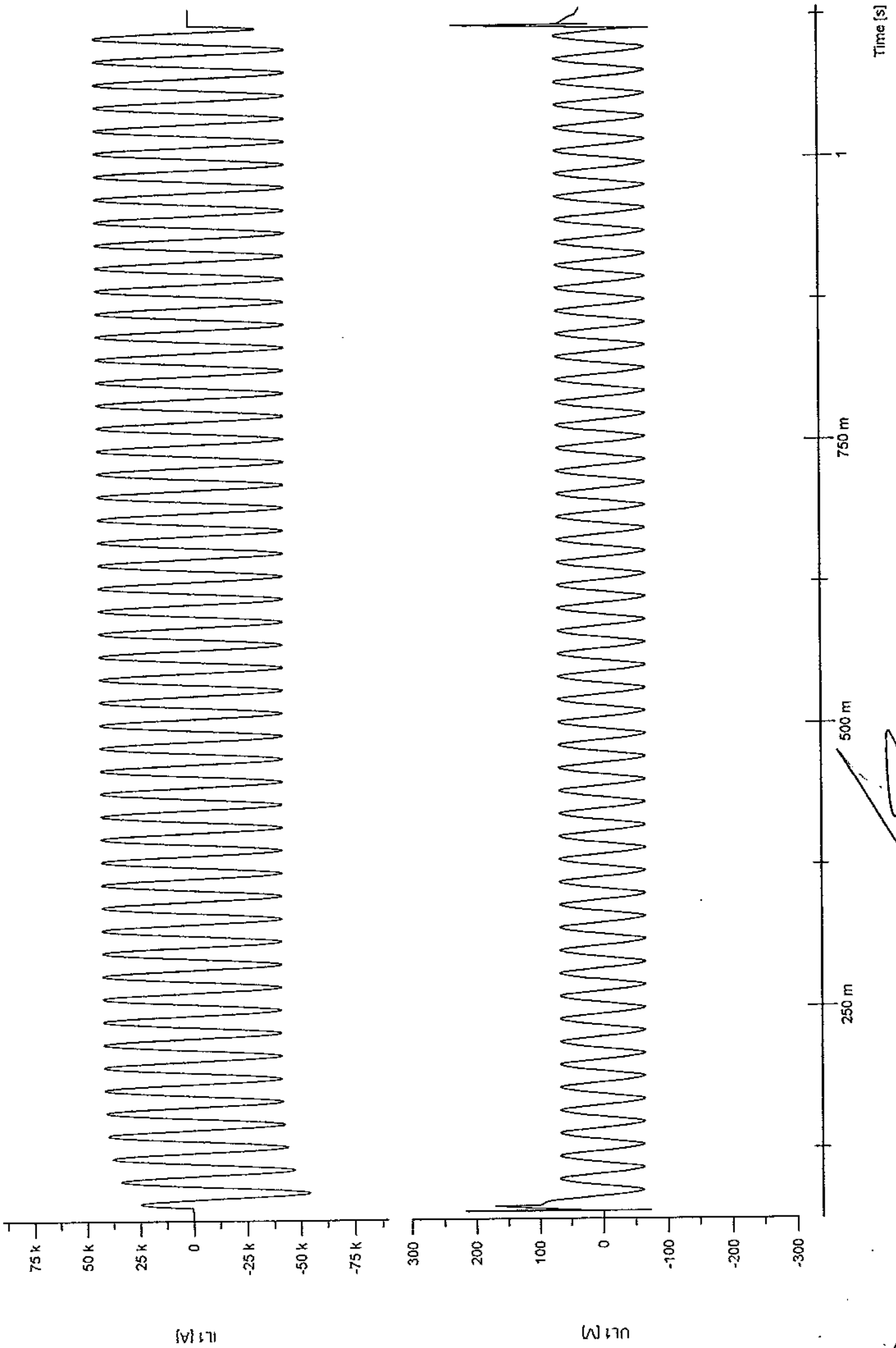
Dynamic Test



ВЯРНО С ОРИГИНАЛА

Oscillogram No. PEHLA 14241Ra / 04

Thermal Test - 1s



Test Results

Power-Frequency Voltage Withstand Tests on Primary Terminals and Partial Discharge Measurement after STC Tests

Test performed:	Power-frequency voltage withstand test on primary terminals and partial discharge measurement
Date of test:	19th November 2014
Condition of test object:	As after routine tests, impulse voltage withstand test and short-time current tests
Test frequency:	50 Hz

Temperature ϑ: 23.2 °C Humidity f: 40.0 % Pressure p: 990 hPa
The atmospheric correction factor was not applied.

Test Arrangement:

See photo at page 32

Test performed: **Power-frequency voltage test**

Test arrangement		Test Voltage	Result
Voltage applied to	Earthed	Power frequency voltage in kV	Test duration / disruptive discharges
Primary terminal	Secondary windings and frame	50 $^{1)}$	60 s / 0

Test performed: **Partial discharge measurement**

Pre-stress: 50 kV for 60 s
Background noise level: 0.2 pC

Test arrangement		Result	
Voltage applied to	Earthed	Test voltage for 30 s	
		28.8 kV	16.6 kV
		Partial discharge in pC	
Primary terminal	Secondary windings and frame	≤ 0.2	≤ 0.2

Remarks: -

1) According client's requirements the power frequency voltage test and the partial discharge measurement were done at 100 % of the test voltage

Result: Tests passed

ВЯРНО С ОРИГИНАЛА

Test Results

Power Frequency Voltage Withstand Tests on Secondary Terminals after STC Test

Test performed:	Power-frequency voltage withstand test on secondary terminals
Date of test:	19th November 2014
Condition of test object:	As after routine tests, impulse voltage withstand test, short-time current test and power-frequency withstand test on primary terminals and partial discharge measurement after STC tests
Ambient air temperature:	23.0 °C
Humidity:	40.6 %

- The test voltage of 3 kV, 50 Hz was applied for 60 s in turn between the short circuited terminals of each winding and earth. The frame F and all the other terminals were connected to earth.

Voltage applied to winding	Connected to earth	Test voltage / duration	Result
(1S1-1S2)	(2S1-2S2) + F	3 kV / 60 s	passed
(2S1-2S2)	(1S1-1S2) + F	3 kV / 60 s	passed

Result: Test passed

ВЯРНО С ОРИГИНАЛА

Test Results

Temperature-Rise Test

Test performed:	Temperature-rise test
Date of test:	19th and 20th November 2014
Condition of test object:	As after routine tests, impulse voltage withstand, short-time current tests and voltage tests after STC tests
Connections to test object:	Infeed of current to the primary winding. The infeed bars consist of Cu bars 1 x 60 x 10 mm^2
Duration of test:	15:00 h
Test frequency:	50 Hz

Ambient temperature:

Description	Temperature °C
At the beginning of test	23.8
At the end of test	24.0

Test current:

Description	Current A
At the beginning of test	720
At the end of test	720

Temperature rise at primary bars:

Measuring point	Description of the measuring point	Nature of measuring point	Final temperature °C	Limited temperature K	Final temperature rise K
1	Left side of infeed bar	One side silver coated Cu in air	49.3	75.0	25.3
2	Right side of infeed bar	One side silver coated Cu in air	48.4		24.4

Calculation of temperature rises of windings according formula:

$$\Theta = \frac{R_{end} - R_{start}}{R_{start}} \times \left(235^{\circ}C + \vartheta_{astart}\right) - \left(\vartheta_{aend} - \vartheta_{astart}\right)$$

Θ	calculated temperature rise
R_{start}	resistance start of test - cold condition
R_{end}	resistance end of test - reaching a stable temperature
∂_{astart}	ambient temperature start test
∂_{aend}	ambient temperature end of test

secondary winding	R_{start}	R_{end}	∂_{astart}	∂_{aend}	Θ	Θ_{lim}
	in Ω	in Ω	in °C	in °C	in K	in K
1S1 - 1S3	5.06	5.56	23.8	24.0	25.4	80.0
2S1 - 2S3	7.68	8.44			25.4	

Remarks:

- The permissible temperature rises are valid for an ambient air temperature of 40 °C.
- The temperatures were measured by thermocouples type L. The thermocouples were inserted into drilling holes and fixed by peening.
- The maximum increase of temperature-rise in the last hour was smaller than 1.0 K.

ВЯРНО С ОРИГИНАЛА

Result: Test passed

Test Results

Accuracy Test after STC Tests and Voltage Tests

Test performed:	Accuracy test
Date of test:	20th November 2014
Condition of test object:	As after routine tests, impulse voltage withstand test, short-time current tests, voltage test after STC tests and temperature-rise test
Ambient air temperature:	23.3 °C
Humidity:	39.9 %

Test performed: **Test for ratio error**

accuracy class		0.5							
rated current primary / secondary	A	600 / 1							
test current	%	120	100	20	5	120	100	20	5
	A	720	600	120	30	720	600	120	30
rated burden	VA	15							
burden during test	VA	15				3.75			
power factor cosφ		0.8				1.0			
limited ratio error	%	0.500	0.500	0.750	1.500	0.500	0.500	0.750	1.500
limited ratio error after STC	%	0.250	0.250	0.375	0.750	0.250	0.250	0.375	0.750
ratio error before STC	%	0.038	0.007	-0.186	-0.616	0.198	0.192	0.140	-0.010
upper limit of ratio error after STC	%	0.288	0.257	0.189	0.134	0.448	0.442	0.515	0.740
lower limit of ratio error after STC	%	-0.212	-0.243	-0.561	-1.366	-0.052	-0.058	-0.235	-0.760
ratio error after STC	%	0.017	-0.004	-0.227	-0.610	0.186	0.178	0.116	-0.003

secondary winding 2S1 - 2S2

accuracy class		5P	
rated current primary / secondary	A	600 / 1	
test current	%	120	100
	A	720	600
rated burden	VA	15	
burden during test	VA	15	
power factor cosφ		0.8	
limited ratio error	%	1	
limited ratio error after STC	%	0.5	
ratio error before STC	%	-0.102	-0.107
upper limit of ratio error after STC	%	0.398	0.393
lower limit of ratio error after STC	%	-0.602	-0.607
ratio error after STC	%	-0.105	-0.107

Test performed: **Test for composite error**

secondary winding 2S1 - 2S2

accuracy class		5P
limited comp. error before STC test	%	5
limited comp. error after STC test	%	2.5
composite error before STC	%	0.1
limit comp. Erro after STC	%	2.6
composite error after STC	%	0.1

Result: Test passed

ВЯРНО С ОРИГИНАЛА

Photos

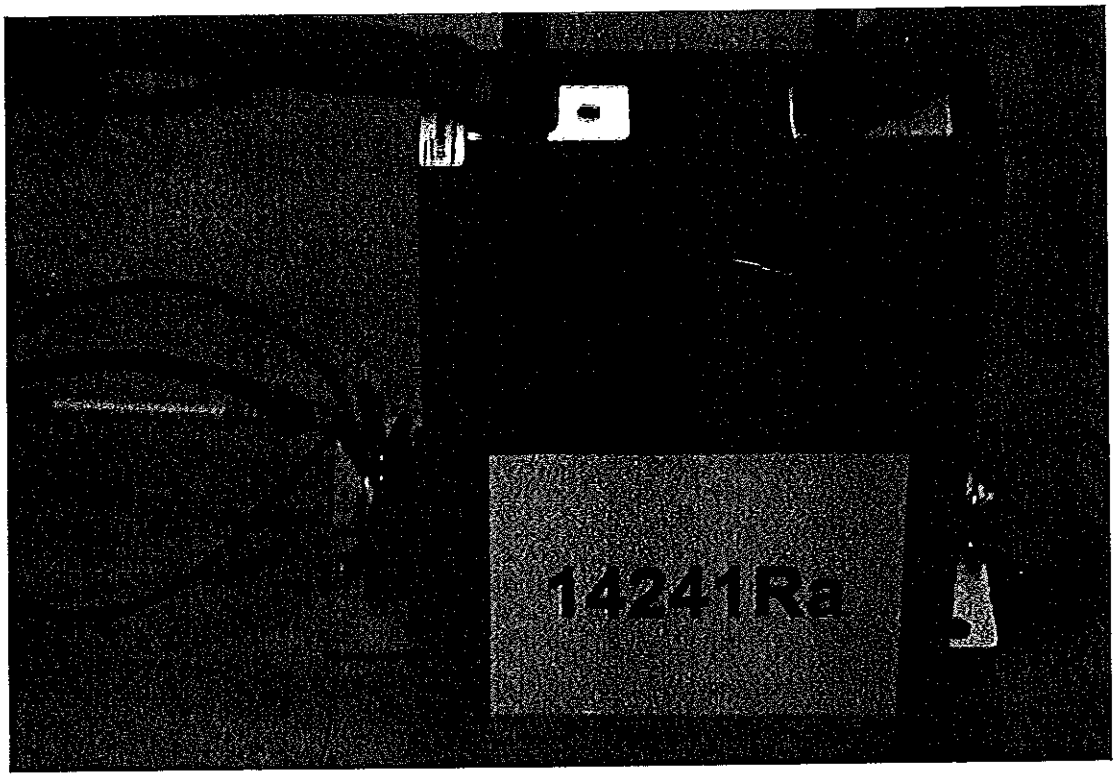


Photo No. 01:
During accuracy test

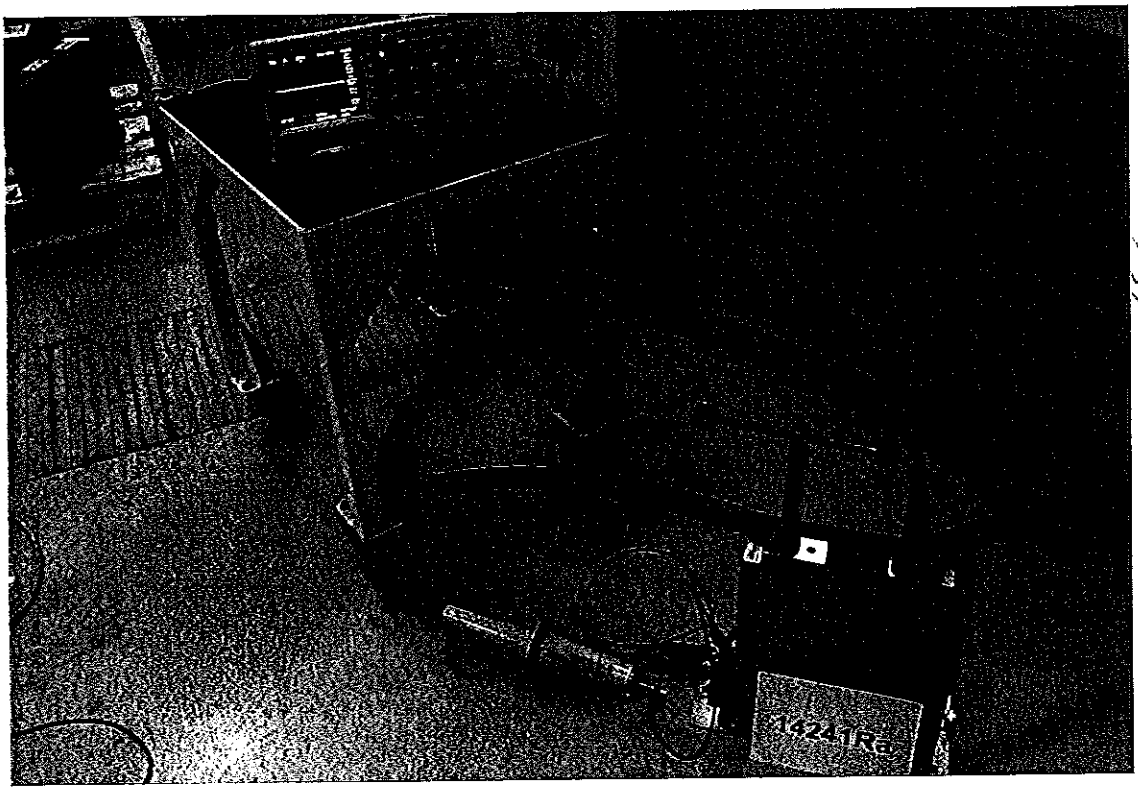


Photo No. 02:
During inter-turn overvoltage

ВЯРНО С ОРИГИНАЛА

Photos

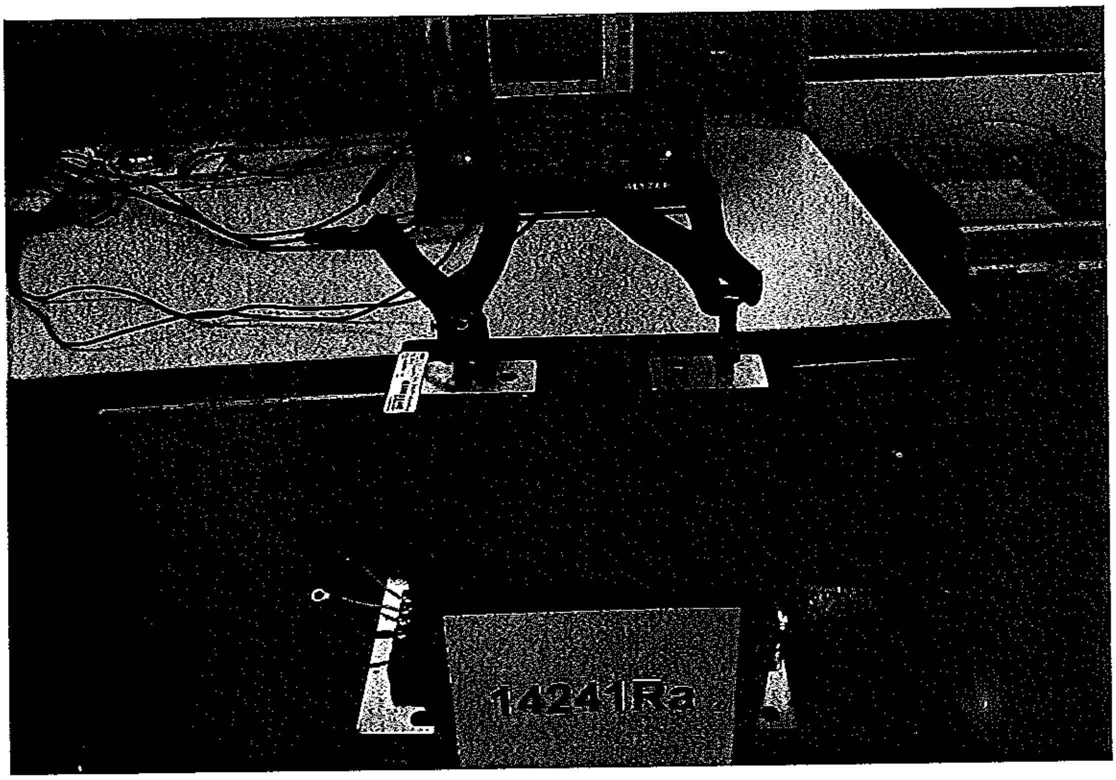


Photo No. 03:
During knee point test

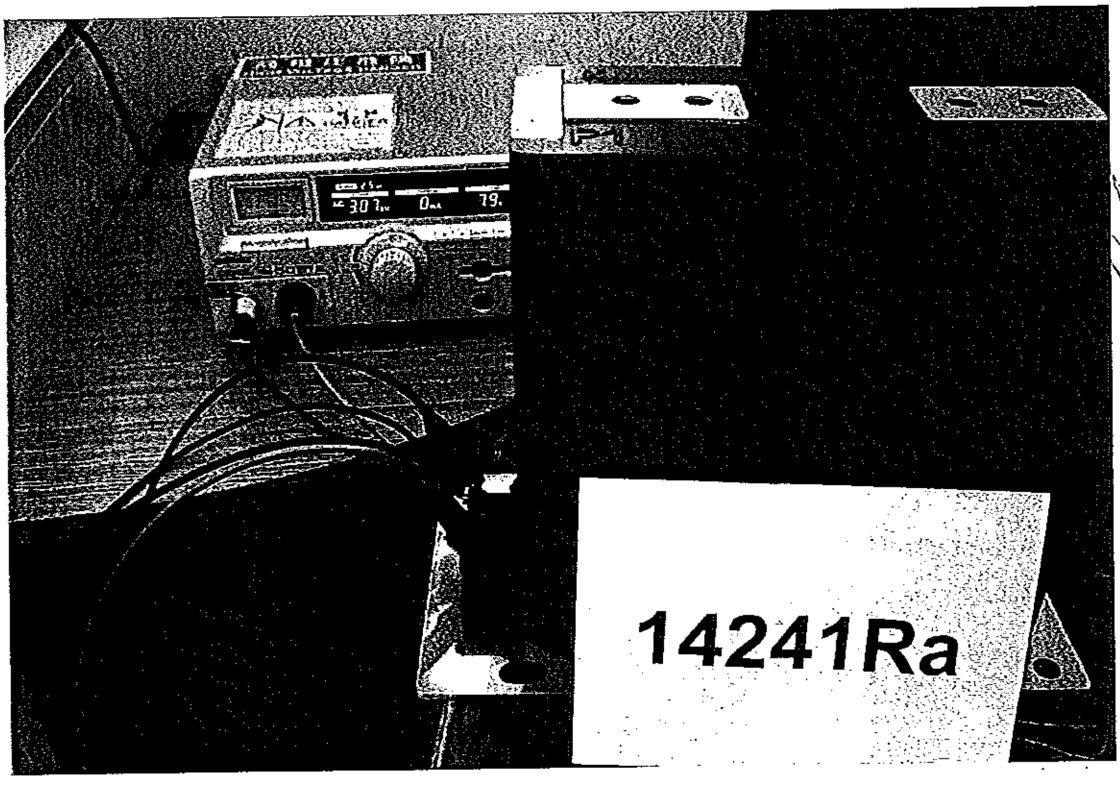


Photo No. 04:
During 3 kV test

Photos

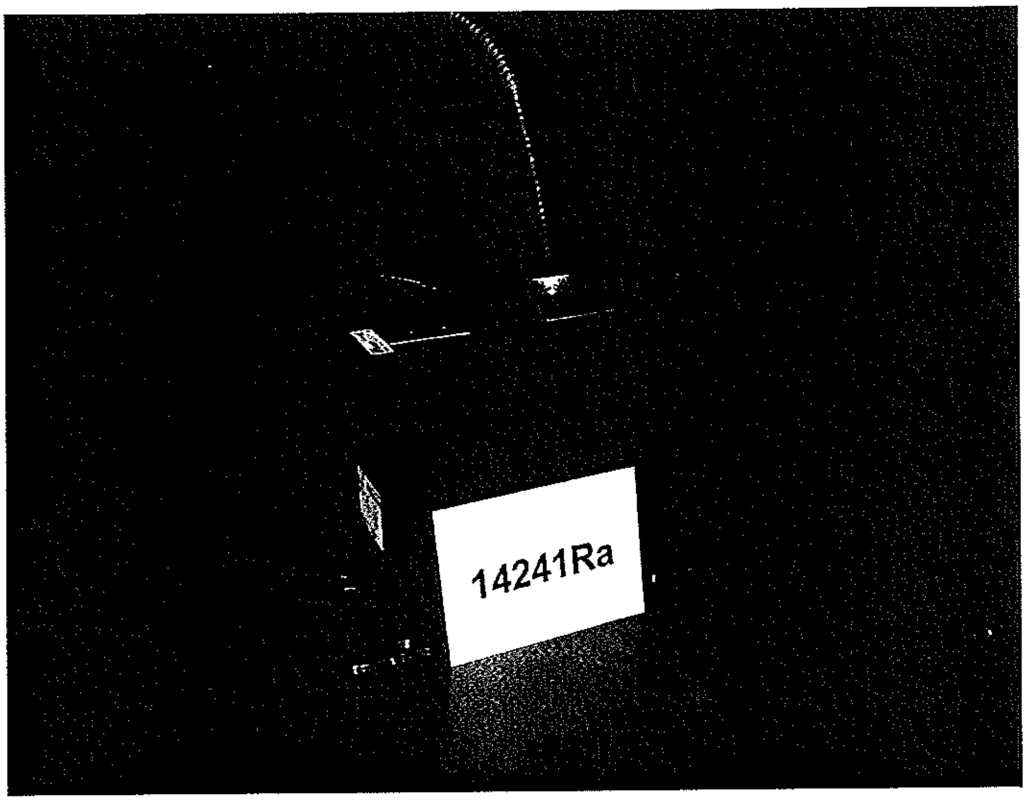


Photo No. 05:
Power frequency and PD test

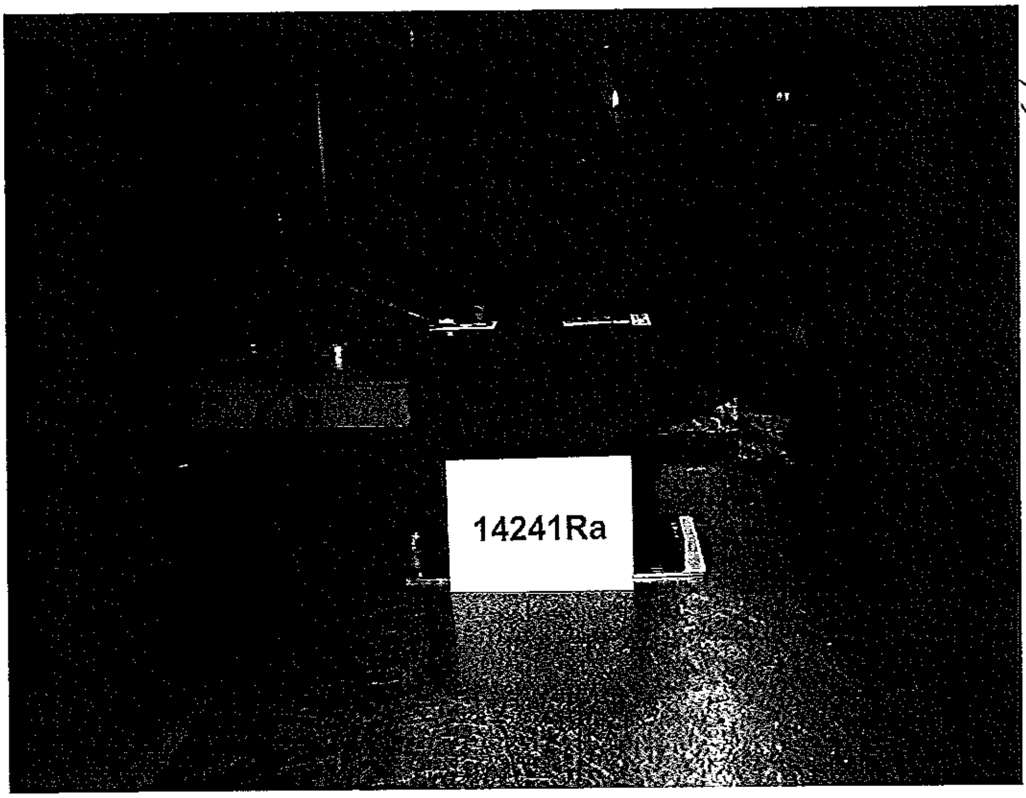


Photo No. 06:
BIL test

ВЯРНО С ОРИГИНАЛА

Photos

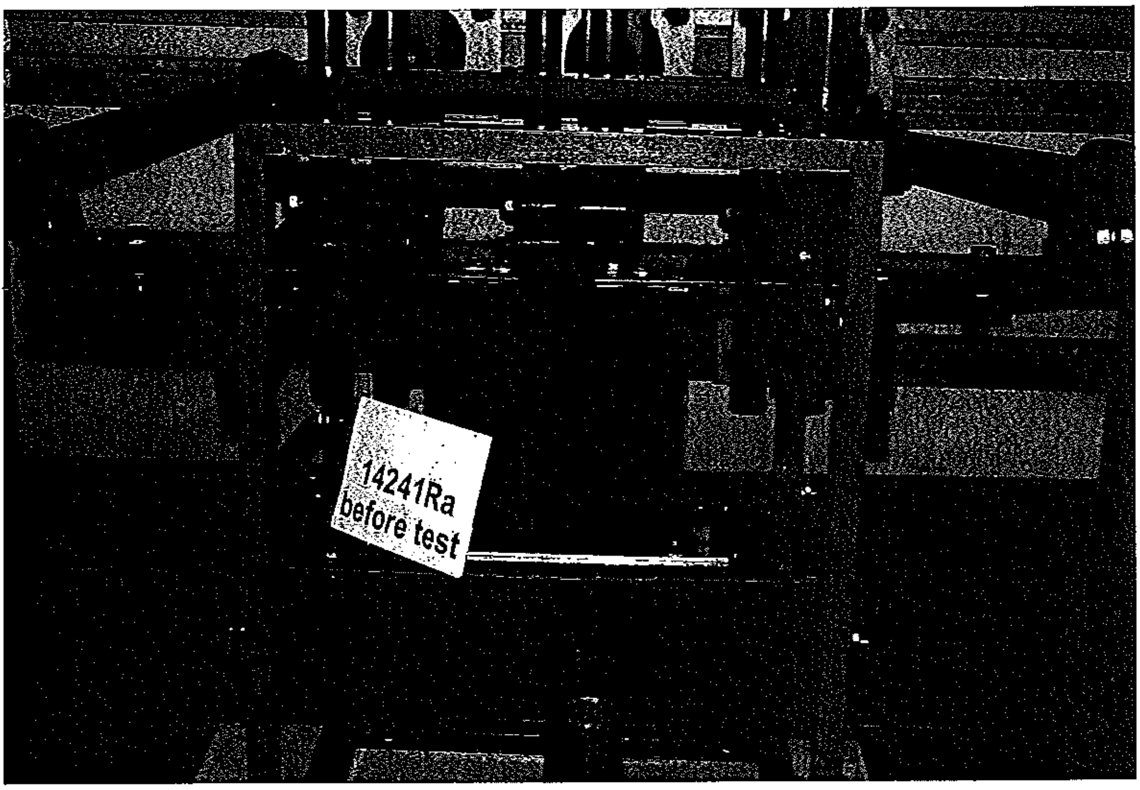


Photo No. 07:
Before STC test

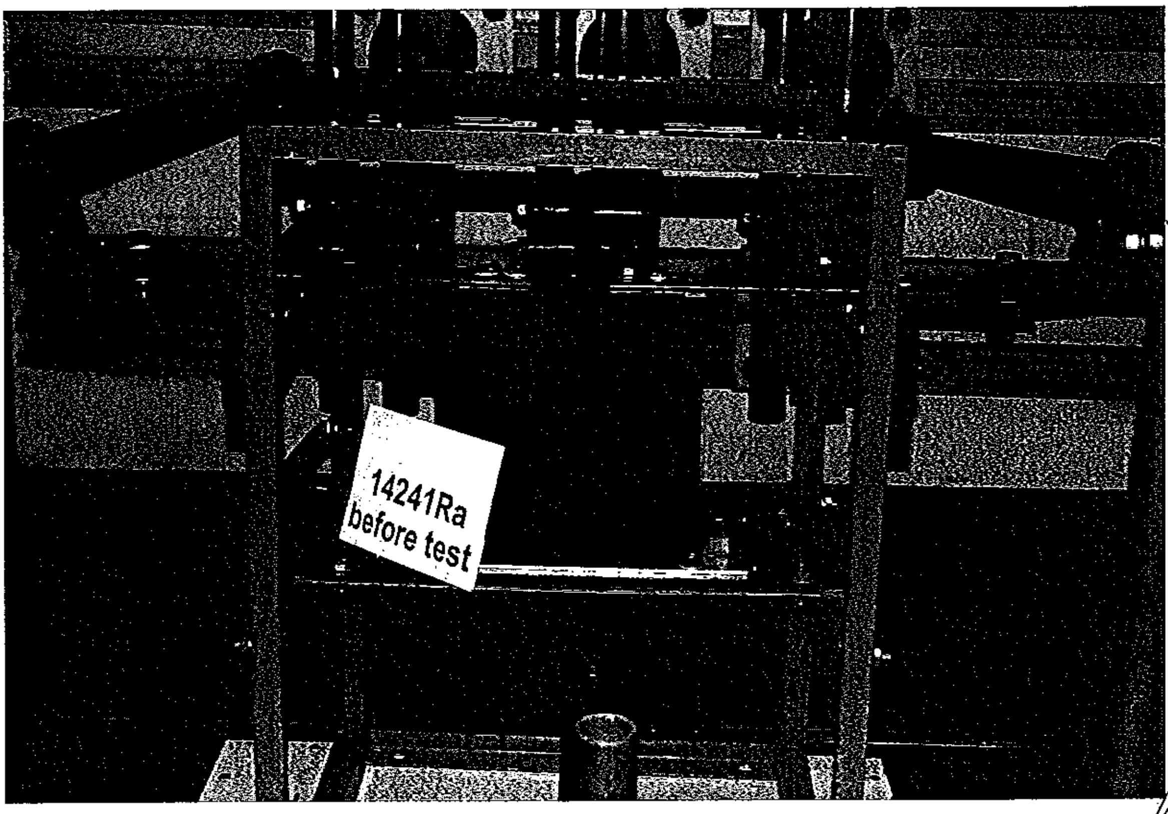


Photo No. 08:
After STC test

ВЯРНО С ОРИГИНАЛА

Photos

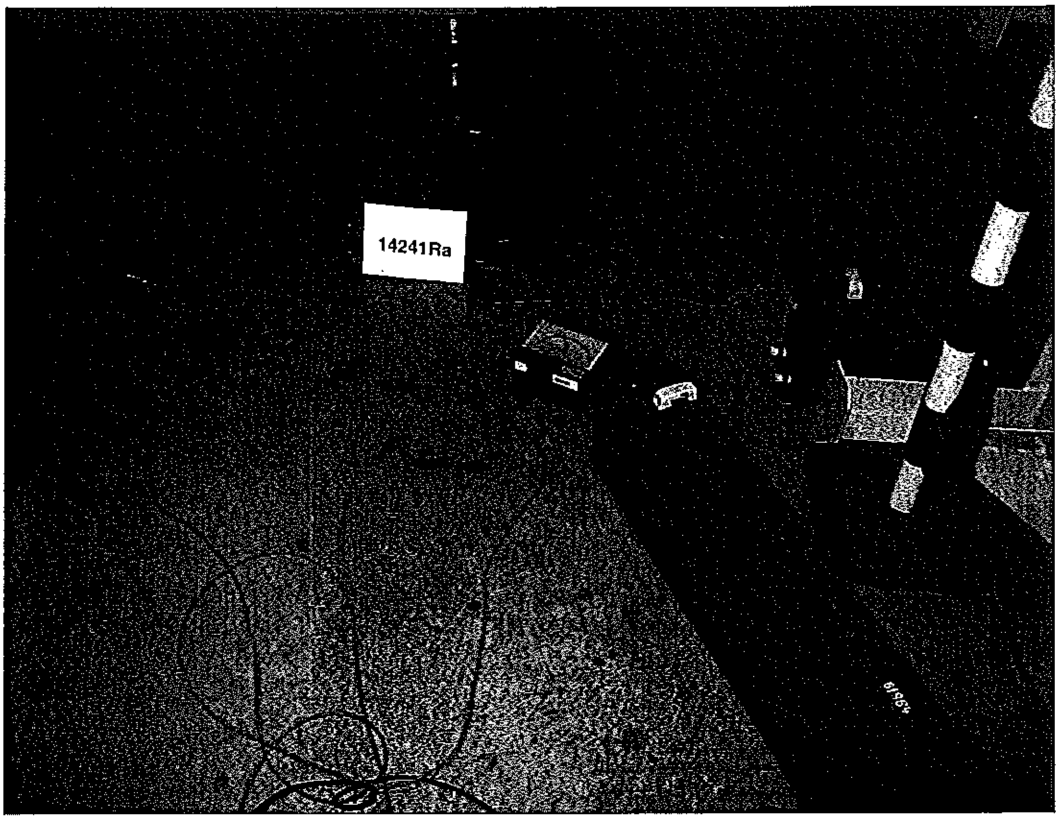


Photo No. 09:
Temperature-rise test

ВЯРНО С ОРИГИНАЛА

Приложение 2.4 - Акредитация на лабораторията на АББ

ВЯРНО С ОРИГИНАЛА

NÁRODNÍ AKREDITAČNÍ ORGÁN

EA MLA Signatory
Český institut pro akreditaci, o.p.s.
Olšanská 54/3, 130 00 Praha 3

issues

according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 852 / 2015

ABB, s.r.o.
with registered office Štětkova 1638/18, 140 00 Praha 4, Company Registration No. 49682563

to the Testing Laboratory No. **1693**
ABB s.r.o. Technical Laboratory PPMV Brno

Scope of accreditation:

Testing of air-insulated high-voltage switchgear and controlgear, instrument current and voltage transformers for high-voltage, electronic instrument current and voltage transformers for high-voltage to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfillment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

In its activities performed within the scope and for the period of validity of this Certificate, the Body is entitled to refer to this Certificate, provided that the accreditation is not suspended and the Body meets the specified accreditation requirements in accordance with the relevant regulations applicable to the activity of an accredited Conformity Assessment Body.

The Certificate of Accreditation is valid until: **11 December 2018**

Prague: 11 December 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

ВЯРНО С ОРИГИНАЛА

The Appendix is an integral part of
Certificate of Accreditation No. 852/2015 of 11/12/2015

Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

The Laboratory is qualified to update standards identifying the test procedures.
The Laboratory provides expert opinions and interprets test results.

Tests:

Ordinal number 1)	Test procedure/method name	Test procedure/method identification	Tested object
1.1	Temperature rise test	IEC 61869-1 ed.1, p.7.2.2 IEC 61869-2 ed.1, p.7.2.2 ČSN EN 61869-1 p. 7.2.2 ČSN EN 61869-2 p. 7.2.2	Instrument current transformers
1.2	Impulse voltage withstand test on primary terminals	IEC 61869-1 ed.1, p. 7.2.3 IEC 61869-2 ed.1, p. 7.2.3 ČSN EN 61869-1 p. 7.2.3 ČSN EN 61869-2 p. 7.2.3	Instrument current transformers
1.3	Accuracy tests	IEC 61869-2 ed.1, p. 7.2.6, 7.3.5 ČSN EN 61869-2 p. 7.2.6, 7.3.5	Instrument current transformers
1.4	Power-frequency voltage withstand tests on primary terminals	IEC 61869-1 ed.1, p. 7.3.1 IEC 61869-2 ed.1, p. 7.3.1 ČSN EN 61869-1 p. 7.3.1 ČSN EN 61869-2 p. 7.3.1	Instrument current transformers
1.5	Partial discharge measurement	IEC 61869-1 ed.1, p.7.3.2 ČSN EN 61869-1 p. 7.3.2	Instrument current transformers
1.6	Power-frequency voltage withstand tests between sections	IEC 61869-1 ed.1, p. 7.3.3 ČSN EN 61869-1 p. 7.3.3	Instrument current transformers
1.7	Power-frequency voltage withstand tests on secondary terminals	IEC 61869-1 ed.1, p. 7.3.4 ČSN EN 61869-1 p. 7.3.4	Instrument current transformers
1.8	Verification of markings	IEC 61869-1 ed.1, p. 7.3.6 ČSN EN 61869-1 p. 7.3.6	Instrument current transformers
1.9	Determination of the secondary winding resistance	IEC 61869-2 ed.1, p. 7.3.201 ČSN EN 61869-2 p. 7.3.201	Instrument current transformers

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Ordinal number [1]	Test procedure/method name	Test procedure/method identification	Tested object
1.10	Determination of the secondary loop time constant using the Omicron instrument	IEC 61869-2 ed.1, p. 7.3.202 ČSN EN 61869-2 p. 7.3.202	Instrument current transformers
1.11	Measurement of limit current and voltage	IEC 61869-2 ed.1, p. 7.3.203 ČSN EN 61869-2 p. 7.3.203	Instrument current transformers
1.12	Inter-turn overvoltage test	IEC 61869-2 ed.1, p. 7.3.204 ČSN EN 61869-2 p. 7.3.204	Instrument current transformers
1.13	Determination of the remanence factor	IEC 61869-2 ed.1, p. 7.5.1, 2B.2 ČSN EN 61869-2 p. 7.5.1, 2B.2	Instrument current transformers
1.14	Determination of the instrument security factor (FS) of measuring current transformers	IEC 61869-2 ed.1, p. 7.5.2, 2A.5, 2A.6 ČSN EN 61869-2 p. 7.5.2, 2A.5, 2A.6	Instrument current transformers
2.1	Temperature rise test	IEC 61869-1 ed.1, p.7.2.2 IEC 61869-3 ed.1, p.7.2.2 ČSN EN 61869-1 p. 7.2.2 ČSN EN 61869-3 p. 7.2.2	Instrument voltage transformers
2.2	Impulse voltage withstand test on primary terminals	IEC 61869-1 ed.1, p. 7.2.3 IEC 61869-3 ed.1, p. 7.2.3 ČSN EN 61869-1 p. 7.2.3 ČSN EN 61869-3 p. 7.2.3	Instrument voltage transformers
2.3	Accuracy tests	IEC 61869-3 ed.1, p. 7.2.6, 7.3.5 ČSN EN 61869-3 p. 7.2.6, 7.3.5	Instrument voltage transformers
2.4	Power-frequency voltage withstand tests on primary terminals	IEC 61869-1 ed.1, p. 7.3.1 IEC 61869-3 ed.1, p. 7.3.1 ČSN EN 61869-1 p. 7.3.1 ČSN EN 61869-3 p. 7.3.1	Instrument voltage transformers

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Vídeňská 117, 119 00 Brno

Ordinal number [1)]	Test procedure/method name	Test procedure/method identification	Tested object
2.5	Partial discharge measurement	IEC 61869-1 ed.1, p.7.3.2 IEC 61869-3 ed.1, p.7.3.2 ČSN EN 61869-1 p. 7.3.2 ČSN EN 61869-3 p. 7.3.2	Instrument voltage transformers
2.6	Power-frequency voltage withstand tests between sections	IEC 61869-1 ed.1, p. 7.3.3 ČSN EN 61869-1 p. 7.3.3	Instrument voltage transformers
2.7	Power-frequency voltage withstand tests on secondary terminals	IEC 61869-1 ed.1, p. 7.3.4 ČSN EN 61869-1 p. 7.3.4	Instrument voltage transformers
2.8	Verification of markings	IEC 61869-1 ed.1, p. 7.3.6 ČSN EN 61869-1 p. 7.3.6	Instrument voltage transformers
3.1	Insulation electric strength tests	IEC 62271-1 ed.1, p. 6.2 IEC 62271-200 ed.2, p. 6.2 ČSN EN 62271-1 p. 6.2 ČSN EN 62271-200 ed.2, p. 6.2	Metal-enclosed switchgear and controlgear
3.2	Measurement of circuit resistance	IEC 62271-1 ed.1, p. 6.4 IEC 62271-200 ed.2, p. 6.4 ČSN EN 62271-1 p. 6.4 ČSN EN 62271-200 ed.2, p. 6.4	Metal-enclosed switchgear and controlgear
3.3	Temperature-rise tests	IEC 62271-1 ed.1, p. 6.5 IEC 62271-200 ed.2 , p. 6.5 ČSN EN 62271-1 p. 6.5 ČSN EN 62271-200 ed.2, p. 6.5	Metal-enclosed switchgear and controlgear
3.4	Tests of mechanical function	IEC 62271-200 ed.2, p. 6.102 ČSN EN 62271-200 ed.2, p. 6.102	Metal-enclosed switchgear and controlgear

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Vídeňská 117, 119 00 Brno

Ordinal number 1)	Test procedure/method name	Test procedure/method identification	Tested object
3.5	IP code verification IP 2X, IP 3X, IP 4X	IEC 62271-1 ed.1, p. 6.7.1 IEC 62271-200 ed.2, p. 6.7.1 ČSN EN 62271-1 p. 6.7.1 ČSN EN 62271-200 ed.2, p. 6.7.1	Metal-enclosed switchgear and controlgear
3.6	Partial discharge measurement	IEC 62271-1 ed.1, p. 6.2.9 IEC 62271-200 ed.2, p. 6.2.9 ČSN EN 62271-1 p. 6.2.9 ČSN EN 62271-200 ed.2, p. 6.2.9	Metal-enclosed switchgear and controlgear
3.7	Additional tests on auxiliary and control circuits	IEC 62271-200 ed.2, p. 6.10 ČSN EN 62271-200 ed.2, p. 6.10	Metal-enclosed switchgear and controlgear
4.1	Impulse voltage withstand test (Primary voltage terminals Um<300kV)	IEC 60044-7 ed.1, p. 8.2.1 ČSN EN 60044-7 p. 8.2.1	Electronic voltage transformers
4.2	Basic tests	IEC 60044-7 ed.1, p. 8.3.1 ČSN EN 60044-7 p. 8.3.1	Electronic voltage transformers
4.3	Test for accuracy versus temperature	IEC 60044-7 ed.1, p. 8.2.3 ČSN EN 60044-7 p. 8.2.3	Electronic voltage transformers
4.4	Test for accuracy versus frequency	IEC 60044-7 ed.1, p. 8.3.3 ČSN EN 60044-7 p. 8.3.3,	Electronic voltage transformers
4.5	Test of resistance to overheating	IEC 60044-7 ed.1, p. 8.2.4 ČSN EN 60044-7 p. 8.2.4	Electronic voltage transformers
4.6	Impulse voltage withstand test for low-voltage components	IEC 60044-7 ed.1, p. 8.8 ČSN EN 60044-7 p. 8.8	Electronic voltage transformers

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Vídeňská 117, 119 00 Brno

Ordinal number 1)	Test procedure/method name	Test procedure/method identification	Tested object
4.7	Transient performance test	IEC 60044-7 ed.1, p. 8.9 ČSN EN 60044-7 p. 8.9	Electronic voltage transformers
4.8	Power-frequency withstand tests on primary terminals and partial discharge measurement	IEC 60044-7 ed.1, p. 9.2 ČSN EN 60044-7 p. 9.2	Electronic voltage transformers
4.9	Power-frequency voltage withstand test for low-voltage components	IEC 60044-7 ed.1, p. 9.3 ČSN EN 60044-7 p. 9.3	Electronic voltage transformers
Hydraulic loss test5.1	Temperature-rise test	IEC 60044-8 ed.1, p. 8.2 ČSN EN 60044-8 p. 8.2	Electronic current transformers
5.2	Impulse voltage withstand test (Primary voltage terminals Um<300kV)	IEC 60044-8 ed.1, p. 8.2.3 ČSN EN 60044-8 p. 8.2.3	Electronic current transformers
5.3	Power-frequency voltage withstand test	IEC 60044-8 ed.1, p. 8.7.3 ČSN EN 60044-8 p. 8.3.7,	Electronic current transformers
5.4	Impulse-voltage withstand test	IEC 60044-8 ed.1, p. 8.7.4 ČSN EN 60044-8 p. 8.7.4	Electronic current transformers
5.5	Basic accuracy tests	IEC 60044-8 ed.1, p. 8.2.9 ČSN EN 60044-8 p. 8.2.9	Electronic current transformers
5.6	Temperature cycle accuracy test	IEC 60044-8 ed.1, p. 8.9.3 ČSN EN 60044-8 p. 8.3.9,	Electronic current transformers
5.7	Test for accuracy versus frequency	IEC 60044-8 ed.1, p. 8.9.4 ČSN EN 60044-8 p. 8.9.4	Electronic current transformers
5.8	Test for composite error	IEC 60044-8 ed.1, p. 8.10.1 ČSN EN 60044-8 p. 8.10.1	Electronic current transformers

Český institut pro akreditaci, o.p.s.

-1-

ВЯРНО С ОРИГИНАЛА

The Appendix is an integral part of
Certificate of Accreditation No. 852/2015 of 11/12/2015

Accredited entity according to ČSN EN ISO/IEC 17025:2005:

ABB s.r.o.
ABB s.r.o. Technical Laboratory PPMV Brno
Vídeňská 117, 119 00 Brno

Ordinal number [1]	Test procedure/method name	Test procedure/method identification	Tested object
5.9	Power-frequency withstand tests on primary terminals and partial discharge measurement	IEC 60044-8 ed.1, p. 9.2 ČSN EN 60044-8 p. 9.2	Electronic current transformers
5.10	Power-frequency voltage withstand test for low-voltage components	IEC 60044-8 ed.1, p. 9.3 ČSN EN 60044-8 p. 9.3	Electronic current transformers

1) Asterisk at the ordinal number identifies the tests, which the Laboratory is qualified to carry out outside the permanent laboratory premises.

Český institut pro akreditaci, o.p.s.
1

ВЯРНО С ОРИГИНАЛА

Приложение 2.4 - Акредитация на лабораторията

ВЯРНО С ОРИГИНАЛА

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

ВЯРНО С ОРИГИНАЛА

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

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The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

ВЯРНО С ОРИГИНАЛА

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
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ВЯРНО С ОРИГИНАЛА

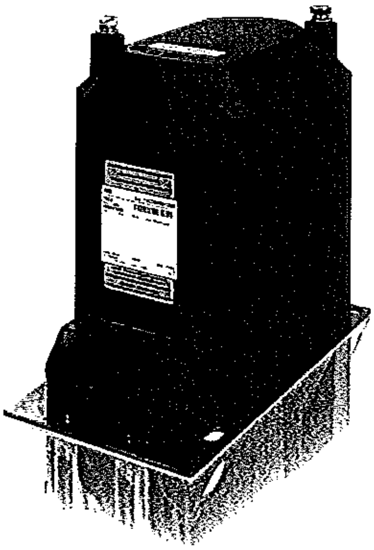
Приложение 3.1 - Каталог TDC 6

ВЯРНО С ОРИГИНАЛА

Medium Voltage Product

TDC 6
Indoor voltage transformers

Highest voltage for equipment	[kV]	17.5 - 24 (25)
Power frequency test voltage, 1 min.	[kV]	38 - 50 (55)
Lightning impulse test voltage	[kV]	95 - 125
Max. rated burden	[VA/cl]	30/0.2 - 100/0.5 - 150/1



Description

The TDC 6 voltage, double-pole insulated transformers are casted in epoxy resin and designed mostly for insulation voltages of 17,5 kV to 24 kV.

Other insulation values are to be the subject of an agreement between the manufacturer and the customer.

If no other value is required the transformers are manufactured with a voltage factor of 1.2 x Un. All the parts of the primary winding of the transformer are insulated from the earth, including the terminals, to an insulation level identical with the rated insulation level. When operating in a three-phase system the primary inlets of the transformer are connected across the respective lines, to the phase-to-phase voltage, mostly in the „V" type of connections. The majority of transformers is equipped with one secondary winding, intended to be used for either the measurement or protection purposes. One of the terminals of each secondary winding has to be earthed during the transformer operation.

If not required otherwise, the secondary winding is lead out into a casted secondary terminal board.

The transformer may be mounted in any position. The transformers are fixed by four screws, The M8 bolted earthing clamp is located on the transformer base plate.

The secondary, sealable terminal board is covered with a transparent cover made of plastic material.

Rated primary voltages ... 11 kV; 15 kV; 20 kV; 22 kV

Other primary voltages based upon customer's request may be delivered, too.

Rated secondary voltages... 100 V; 110 V – 0.2; 0.5 and 1 accuracy classes (measuring winding), or 3P; 6P (protection winding)

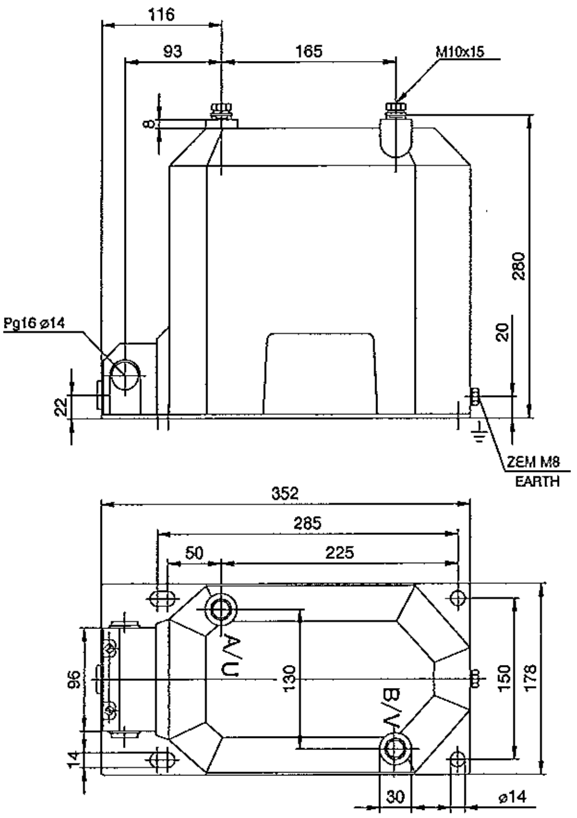
Other secondary voltages based upon customer's request may be delivered, too.

Rated frequency ... 50 Hz; 60 Hz

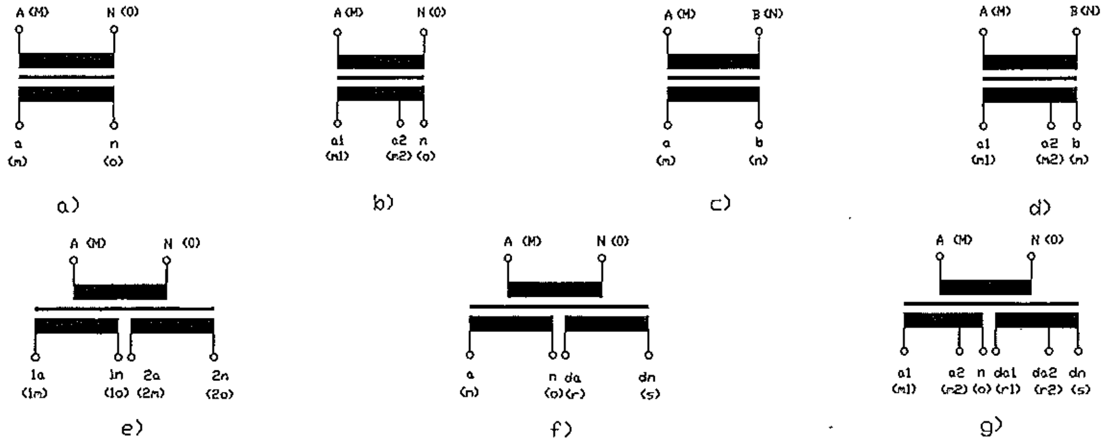
Design for two primary voltages is also possible, based on a consultancy to be conducted with the manufacturer (change over secondary side).

The transformers are manufactured and delivered conformably to the requirements and recommendations of the following standards and regulations: IEC, VDE, ANSI, BS, GOST and ČSN.

Dimensions



Marking of the voltage transformer outlets



a) Single-pole insulated transformer | b) Single-pole insulated transformer with a tap | c) Double-pole insulated transformer | d) Double-pole insulated transformer with a tap | e) Single-pole insulated transformer with two secondary windings | f) Single-pole insulated transformer with two secondary windings, with one of which being the auxiliary (residual) winding | g) Single-pole insulated transformer with two secondary, tapped windings, with one which being the auxiliary (residual) winding.

Standartized transformers

Primary voltage,V	Secondary voltage		
	voltage,V	accuracy	burden, VA
15000	100	0,2	10,15,25
15000	110	0,2	10,15,25
15000	100	0,5	15,25,50
15000	110	0,5	15,25,50
15000	100	1	50,75,100
15000	110	1	50,75,100
20000	100	0,2	10,15,25
20000	110	0,2	10,15,25
20000	100	0,5	15,25,50
20000	110	0,5	15,25,50
20000	100	1	50,75,100
20000	110	1	50,75,100
22000	100	0,2	10,15,25
22000	110	0,2	10,15,25
22000	100	0,5	15,25,50
22000	110	0,5	15,25,50
22000	100	1	50,75,100
22000	110	1	50,75,100

ABB s.r.o.
PPMV Brno
Videnska 117
619 00 Brno, Czech Republic
Tel.: +420 547 152 602
+420 547 152 614
Fax: +420 547 152 626
E-mail: info.ejf@cz.abb.com

www.abb.com

1VLC000523 - Rev. 2, en 2011, 01.15.

Power and productivity
for a better world™

Приложение 3.2 - Удостоверение за одобрен тип

ВЯРНО С ОРИГИНАЛА

ДЪРЖАВНА АГЕНЦИЯ
ЗА МЕТРОЛОГИЯ И
ТЕХНИЧЕСКИ НАДЗОР
STATE AGENCY FOR METROLOGY
AND TECHNICAL SURVEILLANCE

РЕПУБЛИКА
БЪЛГАРИЯ

УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ
Measuring Instrument Type-approval Certificate

№ 06.01.4506

Издадено на: *Issued to:*	"АВВ България" ЕООД, гр. София, ул. "Триадица" № 5
На основание на: *In Accordance with*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г.)
Относно: *In Respect of*	измервателен напрежителен трансформатор за средно напрежение тип TDC.. (TDC 4, TDC 6)
Производител: *Manufacturer*	АВВ EJF s.r.o., Република Чехия
Знак за одобрен тип: *Type Approval Mark:*	BG 06 4506
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	05.01.2016 г.
Вписва се в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4506
Дата на издаване на удостоверението за одобрен тип: *Date:*	05.01.2006 г.

ПРЕДСЕДАТЕЛ:
К. Катеринов

ВЯРНО С ОРИГИНАЛА

Приложение към удостоверение за одобрен тип № 06.01.4506

Издадено на: "АВВ България" ЕООД, гр. София

Относно: измервателен напрежителен трансформатор за средно напрежение тип TDC... (TDC 4, TDC 6)

Описание на типа:

Двуполюсните галванически разделящи напрежителни трансформатори тип TDC ... (TDC 4, TDC 6) са херметизирани с отливка от епоксидна смола и са проектирани за номинално ниво на изолацията от 3,6/10/40 kV до 24 (25)/ 50 (55)/ 125 kV.

Номиналните вторични напрежения са 100 V и 110 V.

По желание на клиента могат да се изработят също и намотки за различни първични и вторични напрежения.

Трансформаторите се произвеждат с фактор на пренапрежение от 1,2x Un.

Възможна е също и изработка с две първични напрежения (с превключване на вторичната страна).

Всички дялове на първичната намотка, включително клемите, се изолират от земя със степен на изолация, съответстваща на номиналната стойност.

Преобладаващата част от трансформаторите са съоръжени с вторична намотка, която служи едновременно за измерване и за релейна защита. Когато не се изисква друго, вторичните намотки са изведени на клеморед от лят тип, покрит с прозрачно капаче от пластмасов материал, което може да се пломбира.

Трансформаторът може да се монтира във всяко положение.

1.1. Технически и метрологични характристики:

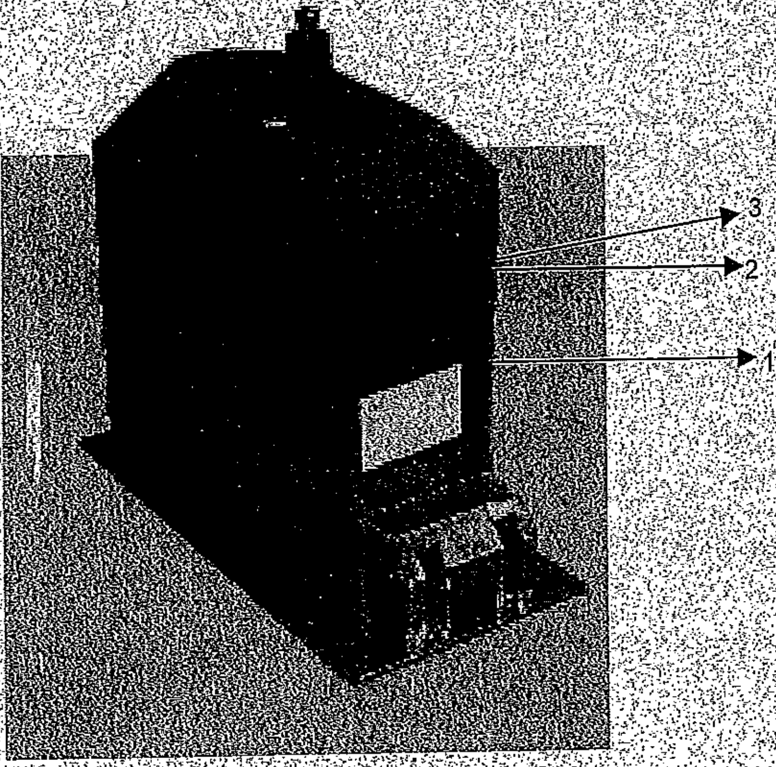
Тип трансформатор	**TDC 4**	**TDC 6**
Максимално напрежение на апарата, kV	от 3,6 до 12	от 17,5 до (25)
Номинално първично напрежение , kV	3; 3,3; 6; 6,6; 10; 11	11; 15; 20; 22
Номинално вторично напрежение , kV	100; 110	
Номинална честота, Hz	50; 60	
Клас на точност: - измервателни намотки - защитни намотки	0,2 ; 0,5; 1 3P; 6P	
Изпитващо напрежение с промишлена честота, kV	от 10 до 28	от 38 до 50 (55)
Изпитващо импулсно напрежение, kV	от 40 до 75	от 95 до 125
Максимален номинален товар/клас, VA/клас	25 VA / 0,2 75 VA / 0,5 150 VA / 1	30 VA / 0,2 100 VA / 0,5 150 VA / 1

1.2. Означаване на типа: TDC 4, TDC 6

ВЯРНО С ОРИГИНАЛА

Приложение към удостоверение за одобрен тип № 06.01.4506

1.3. Схеми на местата за поставяне на знаците, удостоверяващи резултатите от контрола и места за пломбиране.



1. Знак за одобрен тип
2. Знак за първоначална проверка (самозалепваща се марка)
3. Знак за последваща проверка (самозалепваща се марка)

ВЯРНО С ОРИГИНАЛА

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4506.1

КЪМ УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4506

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ABB S.r.o., Република Чехия
На основание на: *In Accordance with:*	чл. 30, ал.2 от Закона за измерванията
Относно: *In Respect of:*	измервателен напрежнов трансформатор за средно напрежение тип TDC...(TDC4; TDC6)
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	14.09.2025 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4506
Дата на издаване на първоначалното удостоверението за одобрен тип: *Date:*	05.01.2006 г.
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	14.09.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

ВЯРНО С ОРИГИНАЛА

Приложение към Допълнение № 15.09.4506.1 към удостоверение № 06.01.4506

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателен напреженов трансформатор за средно напрежение
тип TDC...(TDC4; TDC6)

Описание на допълнение № 15.09.4506.1 към удостоверение за одобрен тип № 06.01.4506

Издаденото допълнение № 15.09.4506.1 към удостоверение за одобрен тип № 06.01.4506 е за удължаване на срока на валидност на одобряване на типа до 14.09.2025 година.

ВЯРНО С ОРИГИНАЛА

Приложение 3.3 - Акредитация

ВЯРНО С ОРИГИНАЛА

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Deutsche Akkreditierungsstelle GmbH
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Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

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IAF: www.iaf.nu

ВЯРНО С ОРИГИНАЛА

Приложение 5.1 - Каталог на TJC 6

ВЯРНО С ОРИГИНАЛА

Приложение 5.1 - Каталог на TJC 6

ВЯРНО С ОРИГИНАЛА

Medium Voltage Product

Indoor voltage transformers

Power and productivity
for a better world™

Parameters	Units
Highest voltage for equipment	17.5 - 24 (25) kV
Power frequency test voltage, 1 min.	38 - 50 (55) kV
Lightning impulse test voltage	95 - 125 kV
Max. rated burden, classes	25/0.2 - 100/0.5 - 150/1 VA/cl
Residual winding	50 - 200/6P VA/cl

Description

The TJC 6 single-pole insulated voltage transformers are cast in epoxy resin and designed mostly for insulation voltages of 17,5 to 25 kV.

Insulation voltages different from the above are the subject of an agreement between the manufacturer and the customer.

If no other value is required the transformers are manufactured with a overvoltage factor of 1.9 x Un/8 hrs. One outlet of the primary winding, including the respective terminal is insulated from the earth to a level which corresponds to the rated insulation value. The transformer is mostly equipped with two secondary windings, the first one for either measuring or protection purposes, the other for being connected into an open-delta connection in a threephase system. One terminal of each secondary winding and one of the open-delta connected terminals have to be earthed during the transformer operation. When not required otherwise, the secondary windings are lead out into a casttype secondary terminal board.

The transformer can be mounted in any position. The transformers are fixed by four screws, the M8 bolted earthing clamp is located on the transformer base plate. The secondary terminal board is covered with a transparent and sealable cover made of plastic material.

Rated primary voltages

11/√3 kV; 15/√3 kV; 20/√3 kV; 22/√3 kV;
Other primary voltages can also be supplied on request.

Rated secondary voltages

100/√3 V; 110/√3 V – accuracy classes 0.2; 0.5; 1 (measuring winding) or 3P; 6P (protection winding).
Other secondary voltages can also be supplied on request.

Rated voltages for open-delta connection

100/3 V; 110/3 V- class 6P.
Other voltages for open-delta connection can also be supplied based on customer requirement.

Rated frequency

50 Hz; 60 Hz.

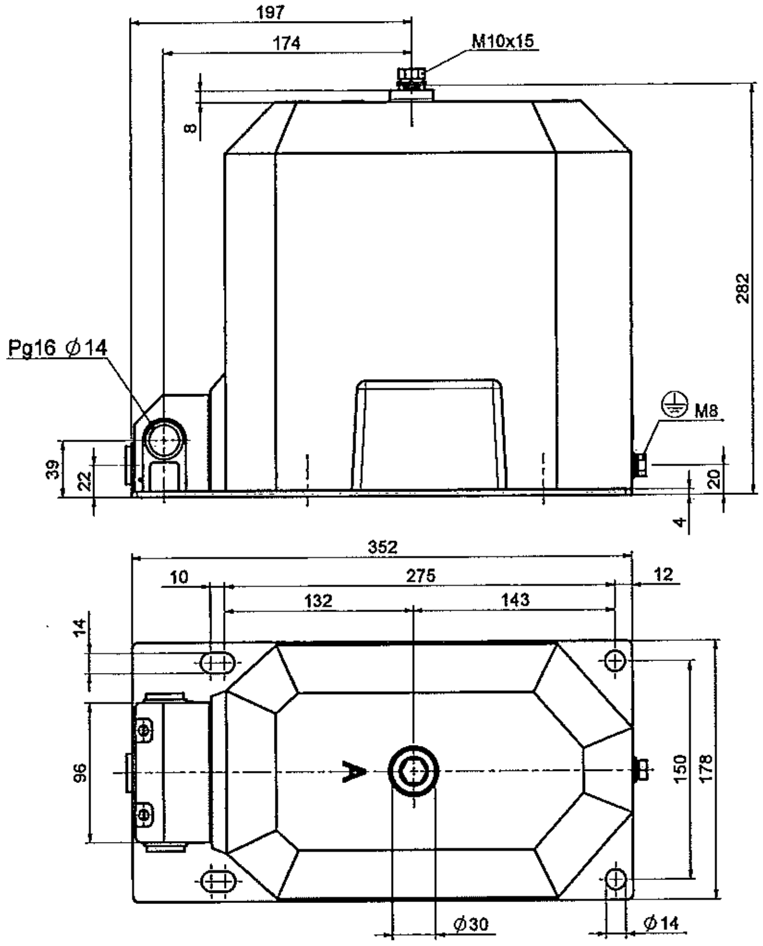
Based on a discussion with the manufacturer the transformer can also be designed for two primary voltage levels (with change over secondary side).

The transformers are manufactured conformably to the requirements and recommendations of the following standards and regulations: IEC, VDE, ANSI, BS, GOST and CSN.

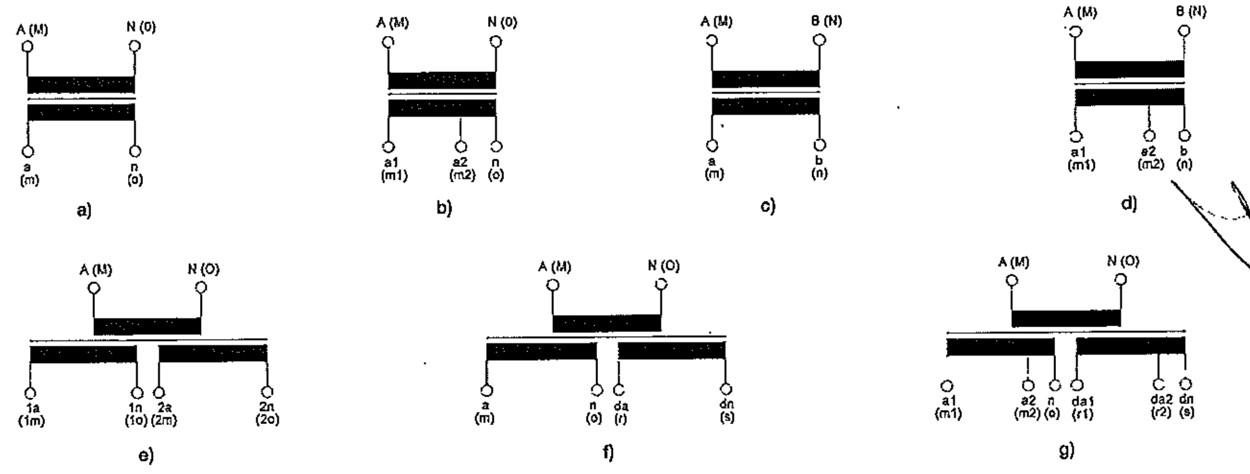
Dimensional Drawing

TJC 6

Weight: appr. 20 kg
Creepage Distance: 338 mm



Marking of the voltage transformer outlets



a) Single-pole insulated transformer | b) Single-pole insulated transformer with a tap | c) Double-pole insulated transformer | d) Double-pole insulated transformer with a tap | e) Single-pole insulated transformer with two secondary windings | f) Single-pole insulated transformer with two secondary windings, with one of which being the auxiliary (residual) winding | g) Single-pole insulated transformer with two secondary, tapped windings, with one which being the auxiliary (residual) winding.

ВЯРНО С ОРИГИНАЛА

Standard execution of the transformers

Primary voltage; [V]	Secondary voltage			Residual winding		
	voltage; [V]	accuracy	burden; [VA]	voltage; [V]	accuracy	burden; [VA]
15 000/√3	100/√3	0.2	10;15;25			
15 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
15 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
15 000/√3	110/√3	0.2	10;15;25			
15 000/√3	110/√3	0.2	10;15;25	110/3	6P	50
15 000/√3	110/√3	0.2	10;15;25	110/3	6P	100
15 000/√3	100/√3	0.5	15;25;50			
15 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
15 000/√3	100/√3	0.5	15;25;50	100/3	6P	100
15 000/√3	110/√3	0.5	15;25;50			
15 000/√3	110/√3	0.5	15;25;50	110/3	6P	50
15 000/√3	110/√3	0.5	15;25;50	110/3	6P	100
15 000/√3	100/√3	1	50;75;100			
15 000/√3	100/√3	1	50;75;100	100/3	6P	50
15 000/√3	100/√3	1	50;75;100	100/3	6P	100
15 000/√3	110/√3	1	50;75;100			
15 000/√3	110/√3	1	50;75;100	110/3	6P	50
15 000/√3	110/√3	1	50;75;100	110/3	6P	100
20 000/√3	100/√3	0.2	10;15;25			
20 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
20 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
20 000/√3	110/√3	0.2	10;15;25			
20 000/√3	110/√3	0.2	10;15;25	110/3	6P	50
20 000/√3	110/√3	0.2	10;15;25	110/3	6P	100
20 000/√3	100/√3	0.5	15;25;50			
20 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
20 000/√3	100/√3	0.5	15;25;50	100/3	6P	100
20 000/√3	110/√3	0.5	15;25;50			
20 000/√3	110/√3	0.5	15;25;50	110/3	6P	50
20 000/√3	110/√3	0.5	15;25;50	110/3	6P	100
20 000/√3	100/√3	1	50;75;100			
20 000/√3	100/√3	1	50;75;100	100/3	6P	50
20 000/√3	100/√3	1	50;75;100	100/3	6P	100
20 000/√3	110/√3	1	50;75;100			
20 000/√3	110/√3	1	50;75;100	110/3	6P	50
20 000/√3	110/√3	1	50;75;100	110/3	6P	100
22 000/√3	100/√3	0.2	10;15;25			
22 000/√3	100/√3	0.2	10;15;25	100/3	6P	50
22 000/√3	100/√3	0.2	10;15;25	100/3	6P	100
22 000/√3	110/√3	0.2	10;15;25			
22 000/√3	110/√3	0.2	10;15;25	110/3	6P	50
22 000/√3	110/√3	0.2	10;15;25	110/3	6P	100
22 000/√3	100/√3	0.5	15;25;50			
22 000/√3	100/√3	0.5	15;25;50	100/3	6P	50
22 000/√3	100/√3	0.5	15;25;50	100/3	6P	100
22 000/√3	110/√3	0.5	15;25;50			
22 000/√3	110/√3	0.5	15;25;50	110/3	6P	50
22 000/√3	110/√3	0.5	15;25;50	110/3	6P	100
22 000/√3	100/√3	1	50;75;100			
22 000/√3	100/√3	1	50;75;100	100/3	6P	50
22 000/√3	100/√3	1	50;75;100	100/3	6P	100
22 000/√3	110/√3	1	50;75;100			
22 000/√3	110/√3	1	50;75;100	110/3	6P	50
22 000/√3	110/√3	1	50;75;100	110/3	6P	100

ВЯРНО С ОРИГИНАЛА

Contact us

ABB s.r.o.
EPMV Brno

Videnska 117, 619 00 Brno,
Czech Republic
Tel.: +420 547 152 021
+420 547 152 614
Fax: +420 547 152 626
E-mail: info.ejf@cz.abb.com

www.abb.com

1VLC000521 Rev.3, en 2016 0.10.06

Power and productivity
for a better world™

Приложение 5.2 - Удостоверение за одобрен тип

ВЯРНО С ОРИГИНАЛА

РЕПУБЛИКА
БЪЛГАРИЯ

ДЪРЖАВНА АГЕНЦИЯ
ЗА МЕТРОЛОГИЯ И
ТЕХНИЧЕСКИ НАДЗОР
STATE AGENCY FOR METROLOGY
AND TECHNICAL SURVEILLANCE

УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ
Measuring Instrument Type-approval Certificate

№ 06.01.4505

Издадено на: *Issued to:*	"АВВ България" ЕООД, гр. София, ул. "Триадица" № 5
На основание на: *In Accordance with:*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г.)
Относно: *In Respect of:*	измервателен напрежителен трансформатор за средно напрежение тип TJC... (TJC 4, TJC 6, TJC 7)
Производител: *Manufacturer:*	ABB EJF s.r.o., Република Чехия
Знак за одобрен тип: *Type Approval Mark:*	E BG 06 4505
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	05.01.2016 г.
Вписва се в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4505
Дата на издаване на удостоверението за одобрен тип: *Date:*	05.01.2006 г.

ПРЕДСЕДАТЕЛ:
К. Катерина

ВЯРНО С ОРИГИНАЛА

страница 1 от 3

Приложение към удостоверение за одобрен тип № 06.01.4505

Издадено на: "АВВ България" ЕООД, гр. София

Относно: измервателен напрежителен трансформатор за средно напрежение тип TJC... (TJC 4, TJC 6, TJC 7)

Описание на типа:

Еднополюсните галванически разделящи напржителни трансформатори тип TJC .... (TJC 4, TJC 6, TJC 7) са херметизирани с отливка от епоксидна смола и са проектирани за номинално ниво на изолацията както следва:

- тип TJC 4 - от 3,6/10/40 kV до 12/28/75 kV;
- тип TJC 6 - от 17,5/38/95 kV до 24(25)/ 50(55)/ 125 kV;
- тип TJC 7 - от 36/70/170 kV до 40,5/95/200 kV.

Трансформаторите се изпълняват с две втори чни намотки, първата от които служи едновременно за измерване и за релейна защита, а другата е за свързване в отворен триъгълник при трифазна система.

Вторичните намотки са изведени на клеморед от лят тип, покрит с прозрачно капаче от пластмасов материал, което може да се пломбира.

По желание на клиента могат да се изработят също и намотки за различни първични и вторични напрежения.

Възможна е също и изработка с две първични напрежения (с превключване на вторичната страна).

Трансформаторите се произвеждат с фактор на пренапрежение от 1,9x Un/8 часа.

Трансформаторът може да се монтира във всяко положение.

1.1. Технически и метрологични характристики:

Тип трансформатор	TJC 4	TJC 6	TJC 7
Максимално напрежение на апарата, kV	от 3,6 до 12	от 17,5 до 24(25)	от 36 до 40,5
Номинално първично напрежение , kV	3/√ 3; 3,3/√ 3; 6/√3; 6,6/√ 3; 10/√ 3; 11/√ 3	11/√ 3 ; 15/√ 3 20/√ 3 ; 22/√ 3	30/√ 3; 33/√ 3; 35/√ 3
Номинално вторично напрежение , kV	100/√ 3 ; 110/√ 3		
Номинална честота, Hz	50; 60		
Клас на точност: - измервателни намотки - защитни намотки	0,2 ; 0,5; 1 3P; 6P		
Изпитващо напрежение с промишлена честота, kV	от 10 до 28	от 38 до 50 (55)	от 70 до 95
Изпитващо импулсно напрежение, kV	от 40 до 75	от 95 до 125	от 170 до 200
Максимален номинален товар/ клас , VA/ клас - измервателни намотки	25 / 0,2 50/ 0,5 100 / 1	25 / 0,2 100 / 0,5 150 / 1	50 / 0,2 150 / 0,5 250 / 1
Максимален номинален товар/ клас , VA/ клас - нулева намотка	50-200 / 6P		

ВЯРНО С ОРИГИНАЛА

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.09.4505.1

КЪМ УДОСТОВЕРЕНИЕ ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 06.01.4505

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ABB S.r.o., Република Чехия
На основание на: *In Accordance with:*	чл. 30, ал.2 от Закона за измерванията
Относно: *In Respect of:*	измервателен напреженов трансформатор за средно напрежение тип TJC...(TJC4; TJC6; TJC7)
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	14.09.2025 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	4505
Дата на издаване на първоначалното удостоверението за одобрен тип: *Date:*	05.01.2006 г.
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	14.09.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

ВЯРНО С ОРИГИНАЛА

Приложение към Допълнение № 15.09.4505.1 към удостоверение № 06.01.4505

Издадено на производител: ABB S.r.o., Република Чехия

Относно: измервателен напреженов трансформатор за средно напрежение
тип TJC...(TJC4; TJC6; TJC7)

Описание на допълнение № 15.09.4505.1 към удостоверение за одобрен тип № 06.01.4505

Издаденото допълнение № 15.09.4505.1 към удостоверение за одобрен тип № 06.01.4505 е за удължаване на срока на валидност на одобряване на типа до 14.09.2025 година.

ВЯРНО С ОРИГИНАЛА

Приложение 5.3 - Акредитация

ВЯРНО С ОРИГИНАЛА

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

ВЯРНО С ОРИГИНАЛА

ДЕКЛАРАЦИЯ

за конфиденциалност и извършен оглед на обект по предмета на поръчката

Долуподписаният Георги Николов Табаков в качеството ми на представляващ „Електролукс Табаков и синове“ ООД,участник в процедура за възлагане на обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика“,

ДЕКЛАРИРАМ, ЧЕ:

1/ Представител на участника, когото представлявам е извършил оглед на енергийния обект от обхвата на Обособена позиция 3 /ОП 3/ - Модернизация (ретрофит) на закрита разпределителна уредба 20 kV в подстанция „Верила“;, а именно: п/ст „Верила“ и съм запознат със съществуващото положение в обекта.

2/ Няма да разпространявам поверителна информация, във връзка с извършения оглед на обекта на Възложителя, като ми е известно, че за поверителна се счита всяка информация, относно пропускателния режим в обекта, организацията на работната сила и работния процес, наличното оборудване и техническите схеми на функционирането му, системите за защита и сигурност в обекта и всичко, което е свързано с наличното оборудване, съоръжения и тяхното функциониране в съответния обект.

3/ Прилагам документ за извършен оглед, съставен на място в подстанцията.

Приложение: съгласно текста

Дата 25.07.2017 г. Декларатор:
/Георги Табаков-Управител/

ДЕКЛАРАЦИЯ

за конфиденциалност във връзка с посещение на обект

Долуподписаният Стефан Георгиев Канев
(собствено, бащино и фамилно име)

ЕГН 6612113445, притежаващ лична карта № 640386823, издадена на 30.06.2010

от МВР-Пловдив с постоянен адрес: гр. Пловдив, ЖК "Тракия" бл. 14 вх. Б

Представител на "Електронике Табаков и синове" ООД
(наименование на юридическото лице/физическото лице и вид на търговеца)

Със седалище и адрес на управление:
гр. Пловдив, ул. "Сердика" 9,

заинтересовано лице по смисъла на §2, т.14 от Допълнителните разпоредби на Закона за обществените поръчки за открита процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика ", реф. № PPD 17 - 052, във връзка с посещението на обекта, предмет на обществената поръчка, с цел запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС Верея

ДЕКЛАРИРАМ:

1. Няма да разгласявам по никакъв начин информацията станала ми известна при запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС Верея
2. Наясно съм, че разгласяване на информация по смисъла на настоящата декларация представлява всякакъв вид устно или писмено изявление, предаване наинформация на хартиен, електронен или друг носител, включително по поща, факс или електронна поща, както и всякакъв друг начин на разгласяване наинформация, в това число чрез средствата за масово осведомяване, печатните издания или интернет.

Известна ми е отговорността по чл.313 от Наказателния кодекс.

Дата 19.07.17 г.

Декларатор: ____________
подпис

____
трите имена

Лице на Възложител: Красимир Димитров

ДЕКЛАРАЦИЯ

за приемане на условията в проекта на договор

- Долуподписаният Георги Николов Табаков в качеството ми на представляващ „Електролукс Табаков и синове“ ООД, участник в обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика“, Обособена позиция 3 /ОП 3/ - Модернизация (ретрофит) на закрита разпределителна уредба 20 kV в подстанция „Верила“;

ДЕКЛАРИРАМ, ЧЕ:

Приемам условията в проекта на договор, приложен в документацията за участие.

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

ДЕКЛАРАЦИЯ
за срока на валидност на офертата

Долуподписаният Георги Николов Табаков, притежаващ лична карта №641449027, издадена на 17.11.2010 г..от МВР– гр. Пловдив, адрес с.Белащица, общ.Родопи, обл.Пловдив, ул."Съединение" №2Б в качеството ми на Управител на „Електролукс Табаков и синове" ООД участник в процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика", реф. № PPD 17-052,
Обособена позиция 3 /ОП 3/ - Модернизация (ретрофит) на закрита разпределителна уредба 20 kV в подстанция „Верила";

ДЕКЛАРИРАМ, ЧЕ:

С подаване на офертата за участие в обществената поръчка, направените от нас предложения и поети ангажименти са валидни за срока, посочен в обявлението, считано от крайния срок за подаване на офертите.

Дата 25.07.2017 г. Декларатор:
/Георги Табаков-Управител/

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